

Workshop Manual

(Group 21)

**TAD1240GE, TAD1241GE/VE
TAD1242GE/VE, TWD1240VE**

Workshop Manual

Industrial Engines

TAD1240GE, TAD1241GE/VE, TAD1242GE/VE, TWD1240VE

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Safety information

Introduction

This Service Manual contains descriptions and repair instructions for the Volvo Penta products or product versions listed in the table of contents. This manual should be used together with the Service Manual **Technical data** for the relevant engine. Be sure to use the correct service literature.

Carefully read the safety information and **General information** and **Repair instructions** in the Service Manual before starting service work.

Important

The following special warning symbols are found in the Service Manual and on the product.



WARNING! Warns for the risk of injury, damage to the product or property or that serious malfunctions could arise if the instructions are not followed.



IMPORTANT! Used to draw attention to anything that could cause injury or the malfunction of a product or property.

NOTE: Used to draw attention to important information to facilitate work operations or handling.

To provide an overview of the dangers of which you should always be aware and the precautionary measures that should always be taken, we have listed them here.



Make it impossible for the engine to start. Turn off the current by means of the main switch (or switches) and lock it (them) in the off position before starting service work. Affix a warning sign in the driver's area.



As a rule, all service work should be performed when the engine is switched off. However, some work, such as certain adjustments, requires the engine to be running. Approaching a running engine could be dangerous. Bear in mind that loose-fitting clothes or long hair could get caught in rotating parts and cause serious injury.



If work is performed near a running engine, an incautious movement or dropped tool could in the worst case lead to bodily harm. Be mindful of hot surfaces (exhaust pipes, the turbocharger, charge air pipes, starter elements, etc.) and hot liquids in lines and hoses on an engine that is running or has just been stopped. Before starting the engine, refit all guards and protective elements that were removed in the course of performing service work.



Make sure that the warning and/or information decals affixed to the product are always in plain sight. Replace any decals that have been damaged or painted over.



Never start the engine unless the air filter is fitted. The rotating impeller in the turbocharger could cause serious injuries. Foreign objects in the inlet line could also cause machinery damage.



Never use starter spray or the like to help start the engine. It could cause an explosion in the inlet manifold. Danger of injury.



Start the engine in well-ventilated areas only. If the engine is running in a confined space, exhaust gases and crankcase gases should be conducted away from the engine compartment or workshop area.
















Avoid opening the coolant filler cap when the engine is still hot. Steam or hot coolant could squirt out while the built-up pressure is lost. If necessary, open the filler cap slowly and release pressure in the cooling system. Be extremely careful if a cock, plug or coolant line must be removed while the engine is still hot. Steam or hot coolant could squirt out in an unexpected direction.









Hot oil can cause burns. Avoid getting hot oil on your skin. Make sure that the lubricating system is depressurized before starting any work on it. Never start or run the engine with the oil filler cap removed as oil under pressure could then escape.



Stop the engine before doing any work on the cooling system.

-  If other equipment connected to the engine changes its center of gravity, special lifting devices may be needed to obtain the right balance and ensure safe handling.
- Never perform any work on an engine that is suspended solely from a lifting device.
-  Never work alone when heavy components are to be removed, even if a safe lifting device such as a lockable block and tackle is used. Even if a lifting device is used, two people are generally required; one to handle the lifting device and the other to make sure that the components go clear and are not damaged when lifting.
- Always ensure in advance that there is sufficient space for dismantling to be done without risk of injury or material damage.
-  **WARNING!** Electrical system and fuel system components of Volvo Penta products are designed and manufactured to minimize the risk of explosion and fire. The engine must not be run in environments in which they will be surrounded by explosive media.
-  Always use fuel recommended by Volvo Penta. See the Owner's Manual. Use of a lower grade fuel could damage the engine. On a diesel engine, a poor grade of fuel could lead to binding of the control rod and overrevving of the engine, causing risk of injury and damage. Poor fuel can also give rise to higher maintenance costs.
-  Bear in mind the following when cleaning with high-pressure equipment: never direct the jet of water on seals, rubber hoses, electrical components or the radiator. Never use the high-pressure function when cleaning the engine.
-  Always use protective goggles when performing work in which splinters, grinding sparks and splashes of acid or other chemicals could occur. The eyes are especially sensitive and an injury could result in loss of sight.
-  Avoid getting oil on your skin. Prolonged or recurring contact with oil can remove the skin's natural moisture, resulting in irritation, dehydration, eczema and other skin disorders. From a hygienic point of view, used oil is more harmful than fresh oil. Wear protective gloves and avoid clothes and rags ingrained with oil. Wash regularly, particularly before mealtimes. Use skin lotion intended for this purpose to avoid dehydration and facilitate cleansing of the skin.
-  Most chemicals intended for the product (such as engine and transmission oils, glycol, gasoline and diesel oil) or chemicals for workshop use (such as degreasers, paints and solvents) are injurious to health. Read the instructions on the package carefully. Always follow prescribed safety rules (such as the use of respirators, protective goggles, gloves, etc.). Make sure that other personnel are not unknowingly exposed to substances that are injurious to health such as through the air they breathe. Make provision for good ventilation. Deal with used and surplus chemicals in the prescribed manner.
-  Exercise great care when detecting leaks in the fuel system and testing fuel nozzles. Wear protective goggles. The jets from a fuel nozzle are under very high pressure and have great penetrative power; the fuel can penetrate deep into body tissues and cause serious injury. Risk of blood poisoning.
-  **WARNING!** The engine's pressure pipes should not be bent or reshaped under any circumstances. Damaged pipes must be replaced.
-  All fuels and many chemicals are flammable. Make sure that they cannot be ignited by an open flame or spark. Gasoline, certain dilutants and hydrogen from batteries, when mixed with air in the right proportions, are highly flammable and explosive. No smoking! Provide for adequate ventilation and take the necessary safety measures prior to the start of welding or grinding work in the vicinity. Always keep a fire extinguisher easily accessible at the workplace.
-  Ensure that rags saturated with oil and fuel, used fuel and oil filters are kept in a safe place prior to their disposal. Under certain conditions, spontaneous combustion can occur in oil-ingrained rags. Used fuel and oil filters are environmentally hazardous waste and, together with used lubricating oil, contaminated fuel, residual paint, solvents, degreasers and residual detergents, should be taken to a suitable plant for destruction.
-  Batteries should never be exposed to open flames or electric sparks. Never smoke near the batteries. When the batteries are being charged, they give off hydrogen which, when mixed with air, forms oxyhydrogen gas. This gas is highly flammable and very explosive. A spark, which can occur if the batteries are connected incorrectly, could cause a battery to explode, resulting in injury and damage. Do not disturb the connections when attempting to start (risk of sparks) and do not lean over any of the batteries.

-  Never mistake the positive and negative terminals for each other when installing the batteries. This could cause serious damage to the electrical equipment. Compare with the wiring diagram.
-  Always wear protective goggles when charging and handling batteries. The battery electrolyte contains highly corrosive sulfuric acid. If it gets on your skin, wash the area with soap and plenty of water. If the electrolyte gets in your eyes, rinse them at once with plenty of water and seek medical attention immediately.
-  Stop the engine and cut off the current with the main switch (or switches) before starting work on the electrical system.
-  The clutch should be adjusted with the engine switched off.
-  Use the lifting eyes mounted on the engine when lifting it. Always check that all lifting equipment is in good condition and that it has the right capacity for the job (engine weight plus transmission and extra equipment, if any).
-  To ensure safe handling and avoid damaging components mounted on the top of the engine, it should be lifted using an adjustable lifting beam or one adapted to the engine. All chains or cables should run parallel to each other and as perpendicular as possible to the top of the engine.

General information

About the Service Manual

This Service Manual contains descriptions and repair instructions for the standard versions of the TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE engines.

The Service Manual may show work operations performed on any of the engines listed above. Consequently, the illustrations and photographs showing certain details may not be completely accurate in a number of cases. The repair methods, however, are in all essentials the same. The engine designation and number are given on the type plate (see "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE").

The engine designation and number should always be quoted in all correspondence concerning any of the engines.

The Service Manual is primarily produced for Volvo Penta's service workshops and their qualified personnel. It is therefore assumed that persons using the manual have the necessary basic knowledge and can perform work of a mechanical/electrical nature that occurs in their profession.

Volvo Penta is continuously developing its products and we therefore reserve the right to introduce changes and modifications. All the information in this manual is based on product data available up to the time of printing. Any vitally important changes to the product or service methods that are introduced after that date are announced in the form of Service Bulletins.

Spare parts

Spare parts for the electrical and fuel systems are subject to different national safety requirements. Volvo Penta Original Spare Parts meet these requirements. All types of damage occurring as a result of using non-original Volvo Penta spare parts for the product in question will not be covered under the terms of the warranty as undertaken by Volvo Penta.

Certified engines

For engines certified for nation and regional environmental legislation, the manufacturer undertakes to ensure that the environmental requirements are fulfilled both in new engines and those already in use. The product must correspond to the specimen product that was approved for certification. For Volvo Penta as the manufacturer to be answerable for ensuring that engines in use meet the stipulated environmental requirements, the following requirements as regards service and spare parts must be fulfilled:

The service intervals and maintenance measures recommended by Volvo Penta must be followed.

Only Volvo Penta Original Spare Parts intended for the certified engine version may be used.

Service involving injection pumps, pump settings or unit injectors must always be performed by an authorized Volvo Penta workshop.

The engine must not be rebuilt or modified in any way, except for the accessories and service kits that Volvo Penta has developed for the engine in question.

Installation changes to exhaust pipes and supply air ducts for the engine compartment (ventilation ducts) must not be made indiscriminately as this could affect exhaust emissions. Any security seals must not be broken by non-authorized personnel.



IMPORTANT! When spare parts are required, use only Volvo Penta Original Spare Parts.

If non-original spare parts are used, AB Volvo Penta will no longer be responsible for ensuring that the engine corresponds to the certified version.

All types of injury, damage or costs arising due to the use of non-original Volvo Penta spare parts for the product in question will not be covered under the terms of warranty as undertaken by Volvo Penta.

Repair instructions

The work methods described in the Service Manual apply to a workshop environment. The engine is therefore lifted out of place and mounted on an engine stand. Unless otherwise stated, reconditioning work that does not require the engine to be removed can be performed in situ using the same work methods.

The warning symbols found in this Service Manual (see **Safety information** for their meaning)



WARNING!



IMPORTANT!

Note:

are by no means all embracing as we cannot of course foresee everything that could happen as service work is performed under the most widely varying conditions. So we can only point out the risks we feel could arise as a result of incorrect handling when working in a well-equipped workshop using methods and tools that have been tested by us.

All work operations for which there are Volvo Penta special tools are described in the Service Manual using these tools. Special tools have been developed to ensure as safe and efficient methods of working as possible. It is therefore the obligation of anyone using tools or work methods other than those recommended by us to ensure that there is no risk of injury or material damage and that such use does not result in malfunction.

In a number of cases, there may be special safety rules and user instructions for the tools and chemicals mentioned in the Service Manual. Such rules and instructions must always be followed and there are no special instructions for them in the Service Manual.

The majority of risks can be avoided by taking certain elementary precautions and using common sense. A clean workplace and a clean engine eliminate many risks of injury and faulty operation.

It is extremely important, especially in connection with work on fuel systems, lubrication systems, inlet systems, turbochargers, bearings and seals, to keep out dirt and foreign particles of other kinds. If this is not done, malfunction or a shorter repair life could be the result.

Our common responsibility

Every engine consists of numerous interacting systems and components. The deviation of a component from its technical specification could dramatically increase the environmental impact of an otherwise good engine. It is therefore extremely important for specified wear tolerances to be maintained, for systems with facilities for adjustment to be correctly set and for Volvo Penta Original engine spare parts to be used. The intervals in the engine maintenance schedule must be followed.

Certain systems, such as fuel system components, may require special competence and special testing equipment. For environmental and other reasons, certain components are sealed at the factory. Work on these components must not be performed by persons not authorized for such work.

Bear in mind that the majority of chemical products, if incorrectly used, are hazardous to the environment. Volvo Penta recommends the use of biologically degradable degreasers for all cleaning of engine components unless otherwise expressly stated in the Service Manual. Take care to ensure that oils and residual detergent, etc. are dispatched for destruction and do not inadvertently end up in the environment.

Tightening torques

Tightening torques for vital bolted joints that should be tightened using a torque wrench are listed in "Technical Data: Tightening torques" and are also given in the Service Manual's work descriptions. All tightening torques refer to cleaned threads, bolt heads and contact surfaces as well as lightly oiled or dry threads. If lubricants, thread locking compounds or sealants are required for bolted joints, the type concerned is stated in the work description and in "Tightening torques". The general tightening torques in the table below are applicable to bolted joints for which no special tightening torque is specified. The tightening torque is a guiding value and the joint need not in such case be tightened using a torque wrench.

Size	Tightening torque	
	Nm	lbf.ft.
M5	6	4.4
M6	10	7.4
M8	25	18.4
M10	50	36.9
M12	80	59.0
M14	140	103.3

Torque-angle tightening

In torque-angle tightening the bolted joint is tightened to a specified torque and then additionally tightened through a predetermined angle. Example: at 90° angle tightening the joint is tightened an additional 1/4 turn after the specified tightening torque has been reached, all in the same operation.

Lock nuts

Lock nuts that have been removed must not be reused. New ones must be fitted instead as the locking characteristics of the old nuts deteriorate or are lost if used several times. For lock nuts with a plastic insert, e.g. Nylock®, the tightening torques in the table should be reduced if the Nylock® nut has the same height or thickness as a standard all-metallic hex nut. Reduce the tightening torque by 25% for 8 mm or larger bolt sizes. For higher or thicker Nylock® nuts, where the all-metallic thread is as high as that of a standard hex nut, the tightening torques in the table are applicable.

Strength classes

Nuts and bolts are divided into different strength classes; the strength class is marked on the bolt head. A higher number indicates a stronger material. For example, a bolt marked 10-9 is stronger than one marked 8-8. When undoing bolted joints, it is therefore important to make sure that the bolts are refitted in their original places. When fitting new bolts, check the spare parts catalogue to ensure that the correct type is used.

Sealants

Several different types of sealants and locking fluids are used on the engine. Their properties differ and they are intended for joints of different strengths, temperature ranges, resistance to oil and other chemicals, and for the various materials and clearances in the engine.

For service work to be fully satisfactory it is important that the right types of sealants and locking fluids are used on the joints where such are required.

In the appropriate sections of the Service Manual, we have indicated the agents used in the production of our engines.

Similar agents or agents with corresponding properties but from a different manufacturer should be used in connection with service work.

When using sealing agents and locking fluids, it is important for the surfaces concerned to be free from oil, grease, paint and rust inhibitor. They must also be dry. Always follow the directions of the manufacturer regarding temperature, hardening time and other instructions relating to the product.

Two different basic types of agent are used on the engine. These are characterized by:

RTV agent (Room Temperature Vulcanizing). Used mostly on gaskets, e.g. sealing gasket joints or coated on gaskets. RTV agent is perfectly visible when the component has been dismantled and old RTV agent must be removed before the joint is sealed afresh.

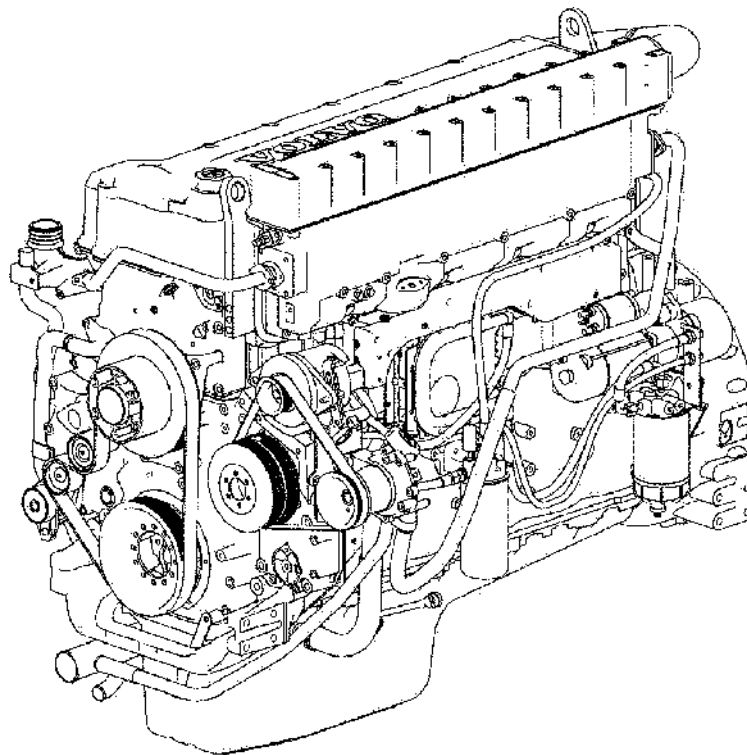
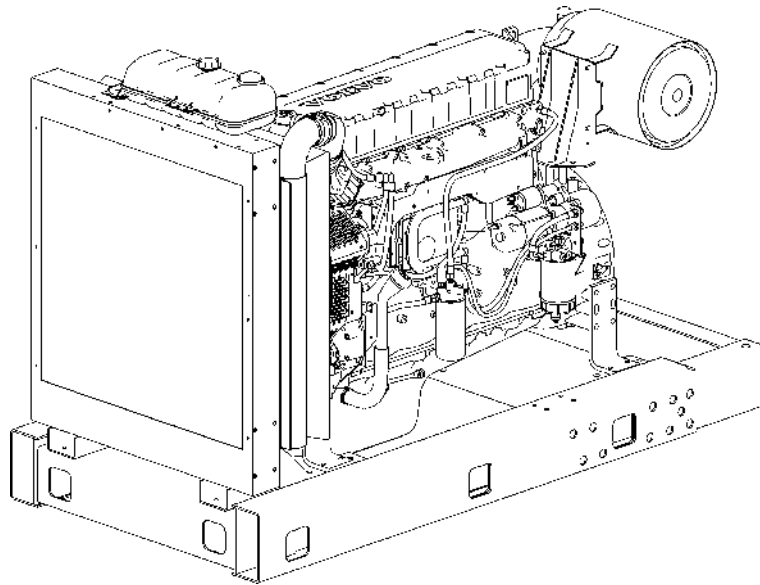
The following agents are of RTV type: Loctite® 574, Volvo Penta 8408791, Permatex® No. 3, Volvo Penta 11610995, Permatex® No. 77. In all cases, old sealant can be removed with denatured alcohol.

Anaerobic agents. These harden in the absence of air. They are used when two solid parts like cast components are fitted together without a gasket. They are also commonly used to secure and seal plugs, the threads of studs, cocks, oil pressure monitors, etc. Hardened anaerobic agents are glass-like; they are therefore colored to make them more visible. Hardened anaerobic agents are highly resistant to solvents and old agent cannot be removed. When refitting a component, thorough degreasing is required followed by application of fresh sealant.

The following agents are anaerobic: Loctite® 572 (white), Loctite® 241 (blue).

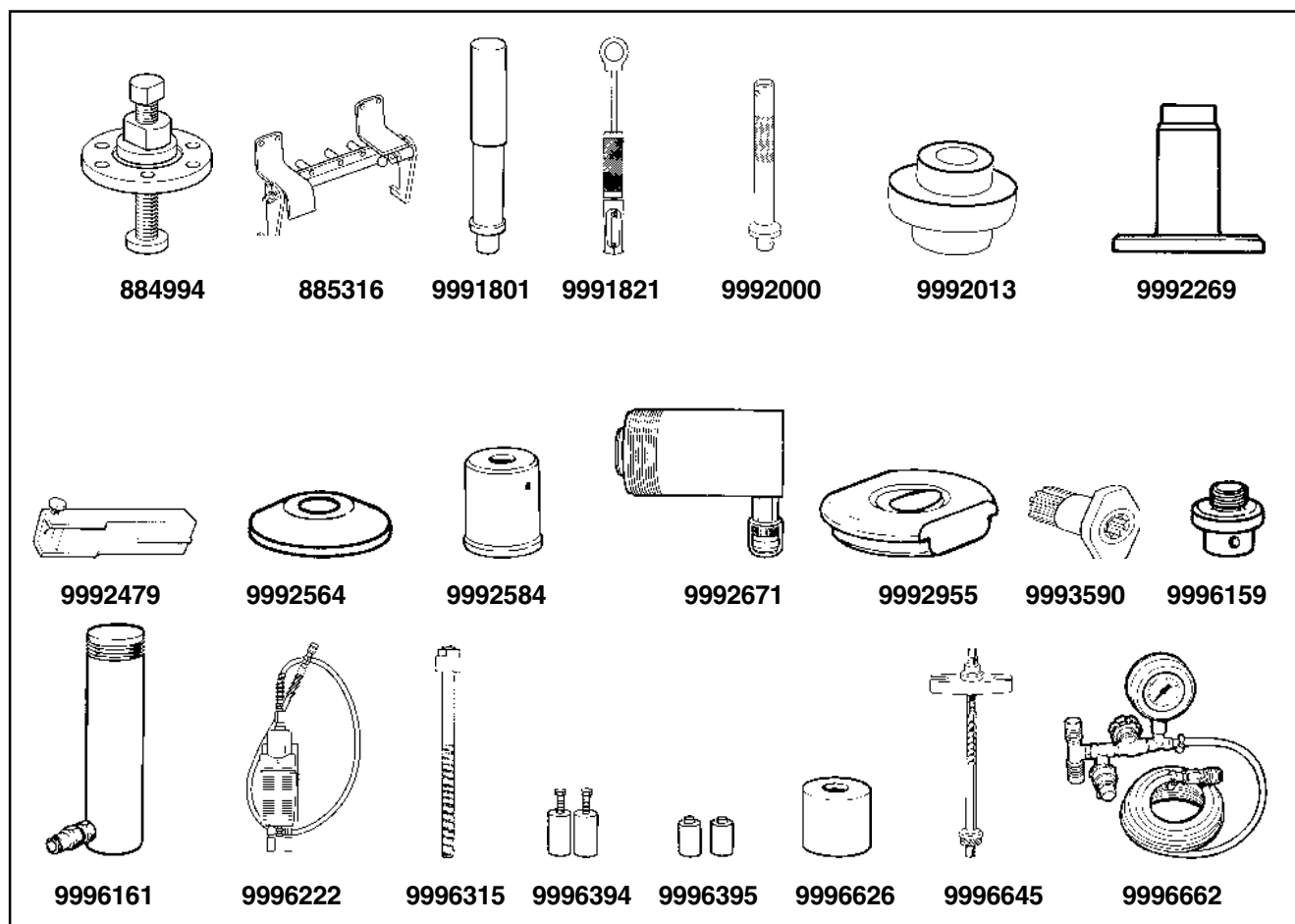
Note Loctite® is a registered trademark of the Loctite Corporation; Permatex® is a registered trademark of the Permatex Corporation.

Group 21 Engine



Tools

Special tools



884994 Puller for polygon hub, vibration damper

885316 Tool for tilting of cylinder head

9991801 Drift for removing piston pin

9991821 Drift for removing flywheel bearing

9992000 Handle for drift 9998238

9992013 Drift for removing and fitting piston pin

9992269 Drift for fitting flywheel bearing

9992479 Holder for dial indicator

9992564 Drift for fitting flywheel bearing

9992584 Adapter for hydraulic cylinder 9992671

9992671 Hydraulic cylinder

9992955 Plate for removing cylinder liner

9993590 Turning tool

9996159 Pin for hydraulic cylinder 9996161

9996161 Hydraulic cylinder for changing cylinder liner, timing gear and valve guides

9996222 Foot pump

9996315 Spindle for fitting polygon hub and crankshaft gear

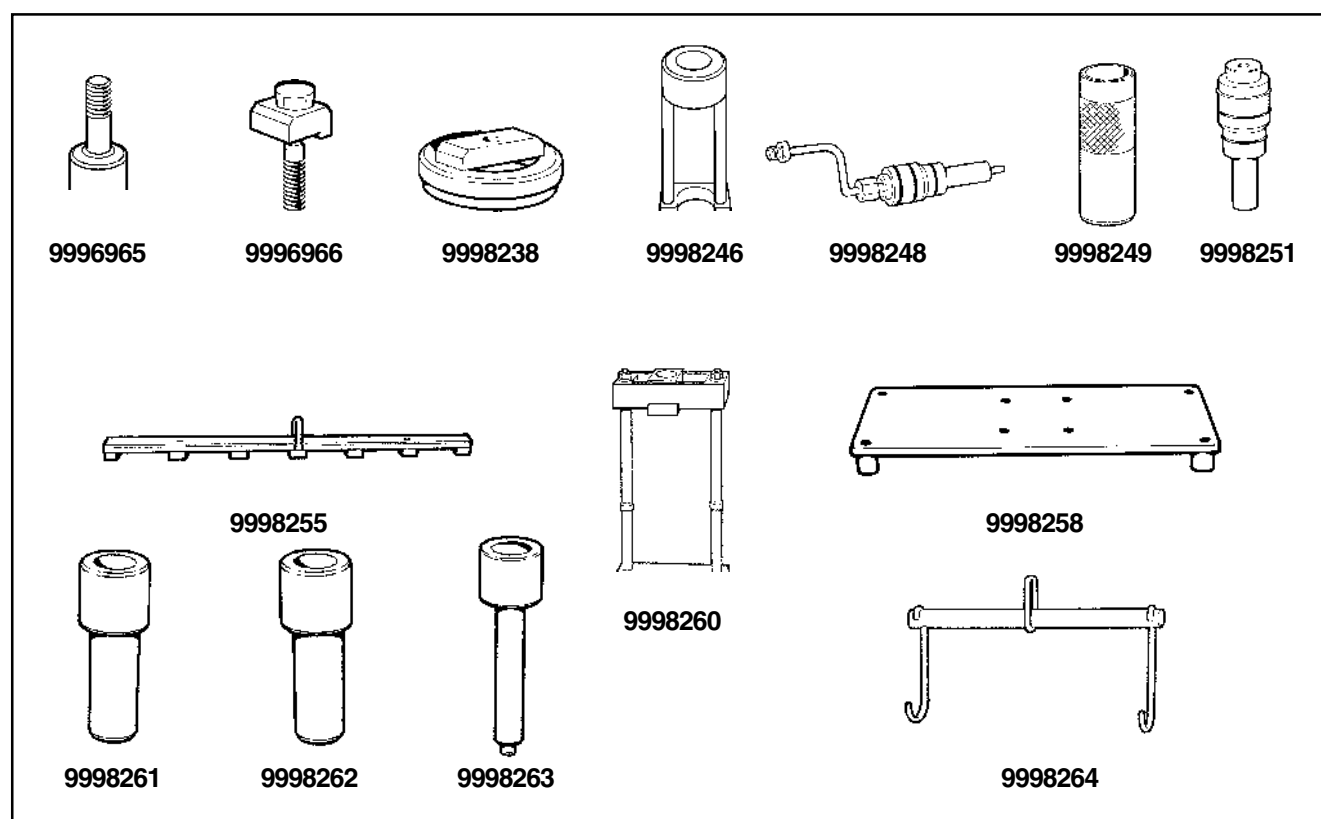
9996394 Spacer for removing cylinder liner

9996395 Spacer for removing cylinder liner

9996626 Adapter for hydraulic cylinder 9992671

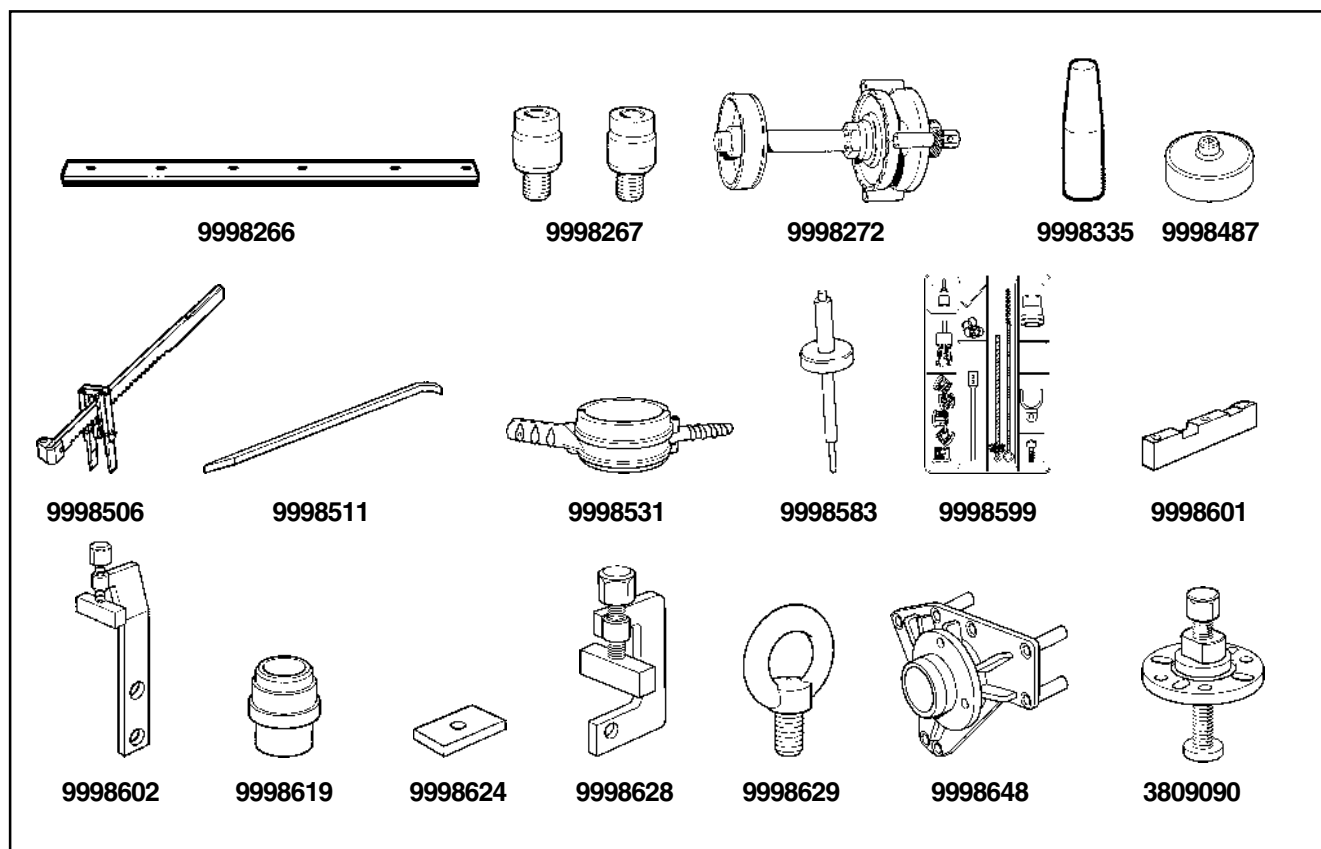
9996645 Puller for cylinder liner

9996662 Pressure gauge



9996965	Adapter for fitting polygon hub
9996966	Press tool for cylinder liner
9998238	Drift for changing crankshaft seal
9998246	Tool for removing and fitting valve spring
9998248	Adapter
9998249	Protective sleeve for unit injector
9998251	Protective plug for cylinder head
9998255	Lifting tool for rocker arm bridge

9998258	Tool for securing cylinder head in engine stand
9998260	Press tool for removing and fitting valve springs and valve guides
9998261	Drift for fitting valve guide
9998262	Drift for fitting valve guide
9998263	Drift for removing valve guide
9998264	Lifting yoke for camshaft



9998266 Sealing washer for leakage check

9998267 Guide pins for timing plate

9998272 Milling tool for cylinder liner seat

9998335 Guide sleeve for valve stem seal

9998487 Puller for oil filter

9998506 Tool for removing and fitting valve spring

9998511 Crowbar

9998531 Piston ring guide

9998583 Gauge for setting unit injector prestress

9998599 Cleaning kit for unit injector

9998601 Securing tool for cylinder head

9998602 Press tool

9998619 Drift for sealing ring

9998624 Securing tool for cylinder head

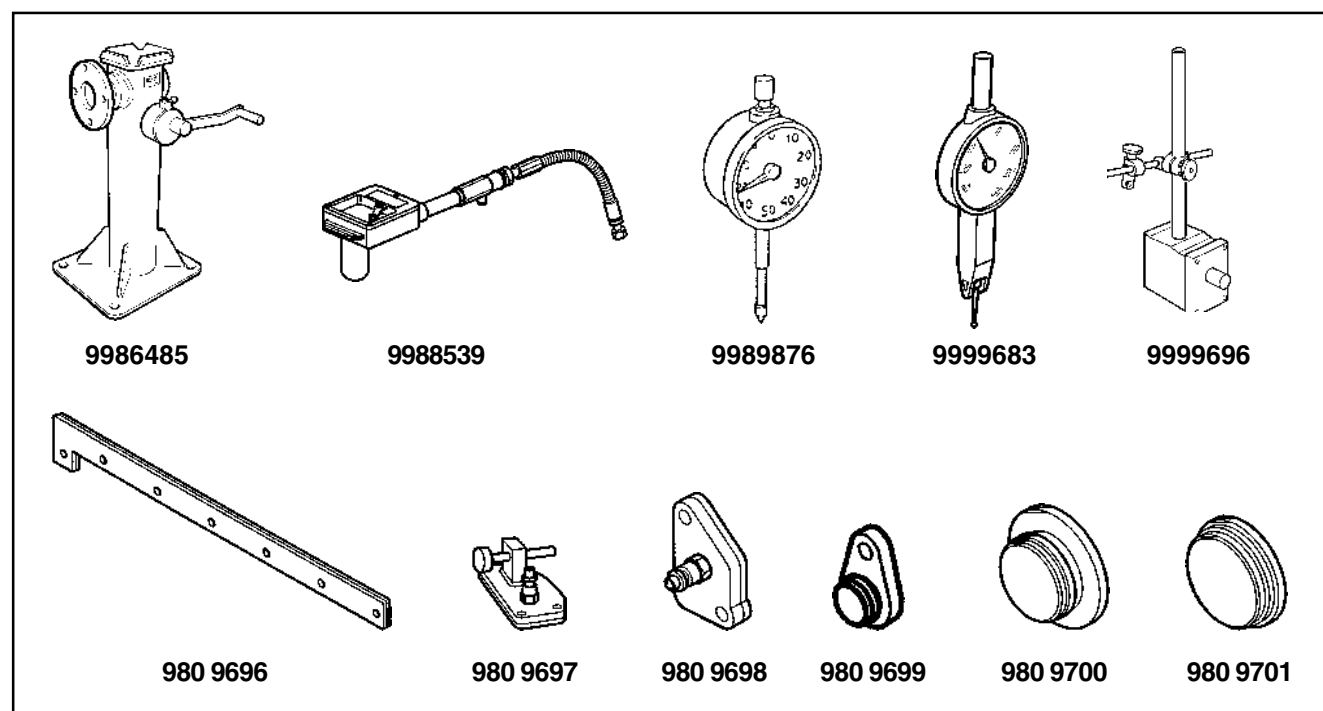
9998628 Press tool

9998629 Lifting eye

9998648 Engine jig

3809090 Puller, polygon hub, vibration damper

Other special equipment



9986485 Engine stand

9988539 Compression tester

9989876 Dial indicator

9998666 Sealing washers, kits: 980 9696,
980 9697, 980 9699

9998668 Connection washers, kits: 980 9698,
980 9700, 980 9701

9999683 Lever type dial gauge

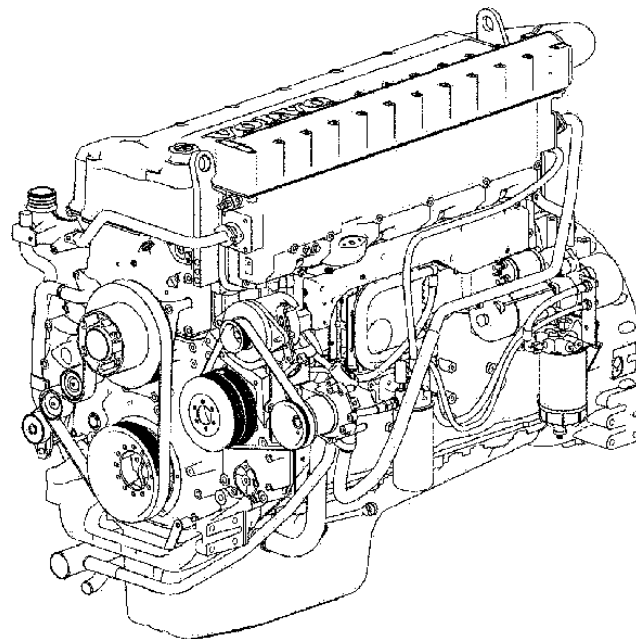
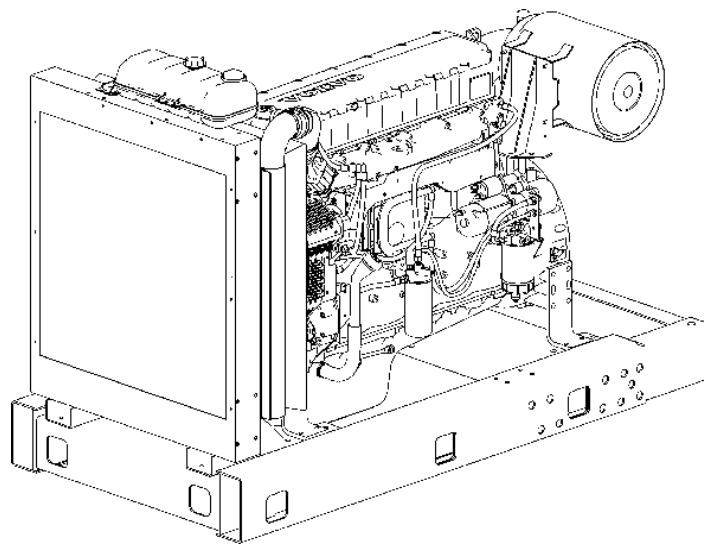
9999696 Magnetic stand

Design and operation

Engine

The TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE are 12-liter engines with cast iron cylinder blocks and wet cylinder liners. The one-piece cylinder head has a single overhead camshaft and a unit injector for each cylinder.

The unit injectors are located in the center above the pistons and are run by the control module. The control module EDC III (Electronic Diesel Control) is located on the left-hand side of the cylinder block.



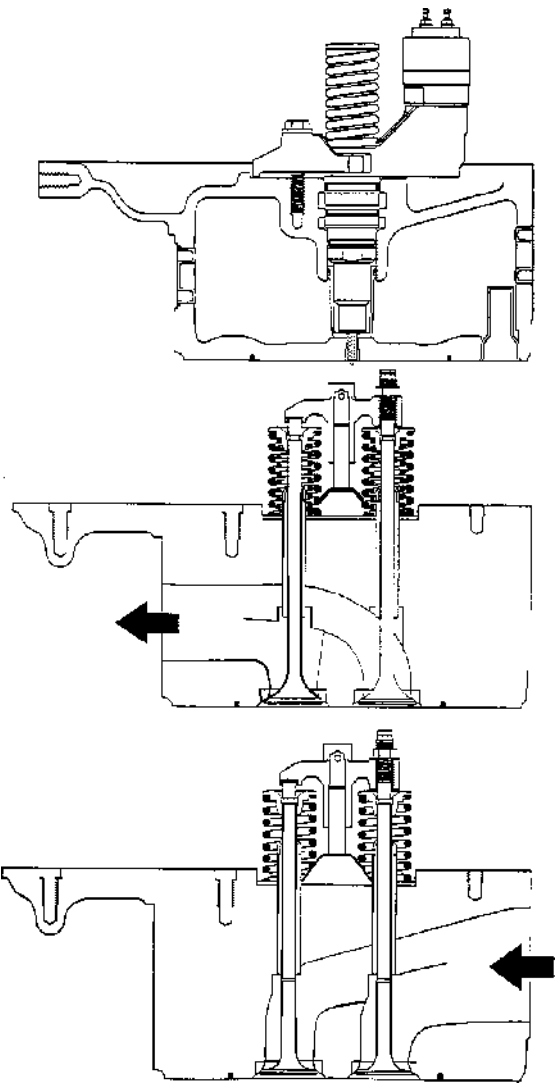
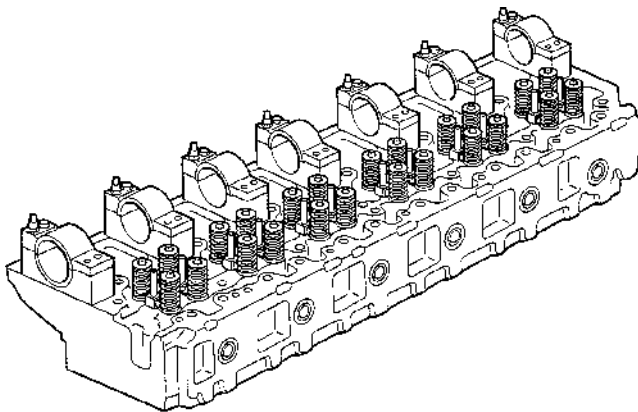
Cylinder head

The cylinder head, which covers all cylinders, has a single overhead camshaft.

The cylinder head is held in place with 38 bolts spaced evenly round the cylinders.

The cylinder head has separate inlet and exhaust ports arranged for crossflow in each cylinder. The valve guides are of alloyed cast iron; the steel valve seats are replaceable. All valve guides have oil seals.

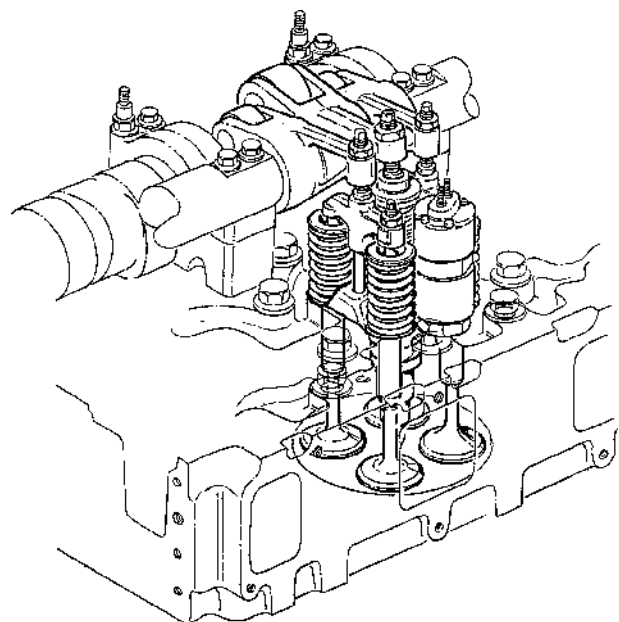
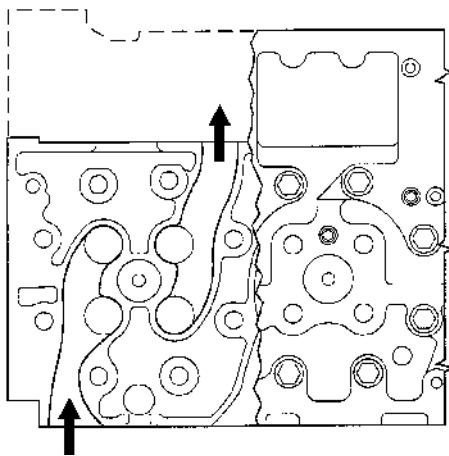
The unit injectors are centrally positioned and surrounded by four valves per cylinder, which ensures uniform combustion chamber geometry. The lower part of the injector is placed in a copper sleeve and the fuel passage for the injectors is machined directly in the cylinder head.



Top: Injectors

Center: Exhaust valves with double springs

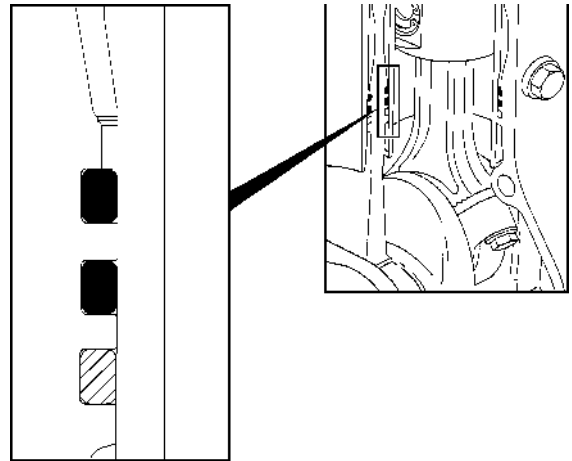
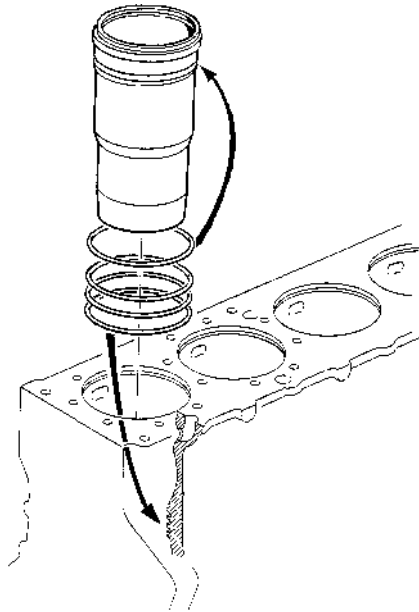
Bottom: Inlet valves



Cylinder block/cylinder liners

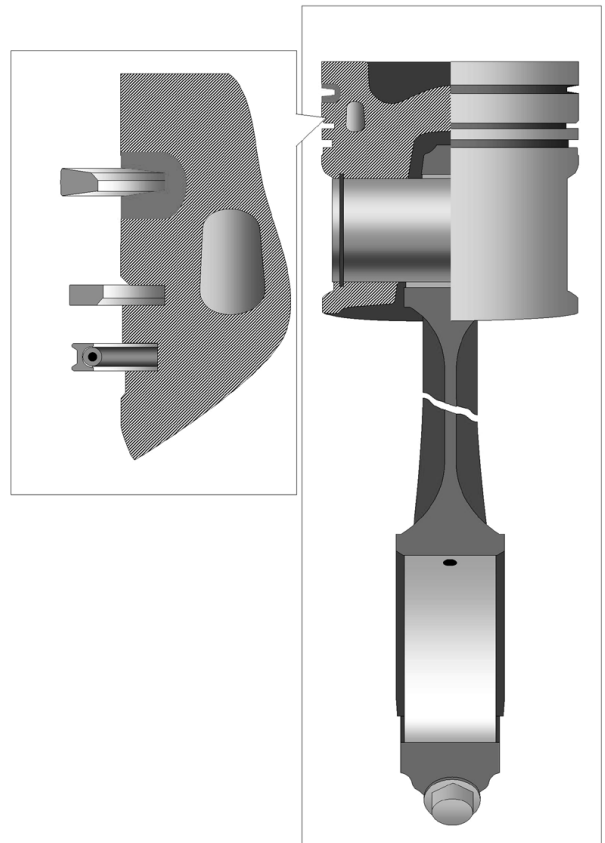
The TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE engines have a cylinder block with wet (replaceable) cylinder liners.

The coolant space (water jacket) round the cylinder liners is sealed against the lower part of the cylinder block by means of three sealing rings.



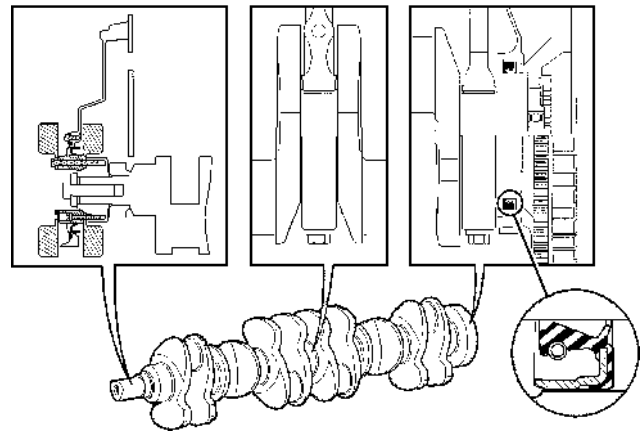
Pistons

The pistons are of aluminum and are cooled by lubricating oil sprayed from below by piston cooling nozzles and in the oil passage.



Crankshaft

The 7-bearing crankshaft is drop forged and induction hardened on bearing surfaces and fillets. The crankshaft has front and rear sealing rings and is usually equipped with double vibration dampers (depending on the engine variant).



Camshaft

The engine has a single overhead camshaft carried in seven bearing housings bolted to the cylinder head.

There are two bearing housing versions, a production housing and a spare part housing.

The bearing housings are numbered from the factory and should not be mixed up if the engine is reconditioned.

Also note that bearing housings and bearing caps are machined together. This applies both to production versions and spare parts versions.

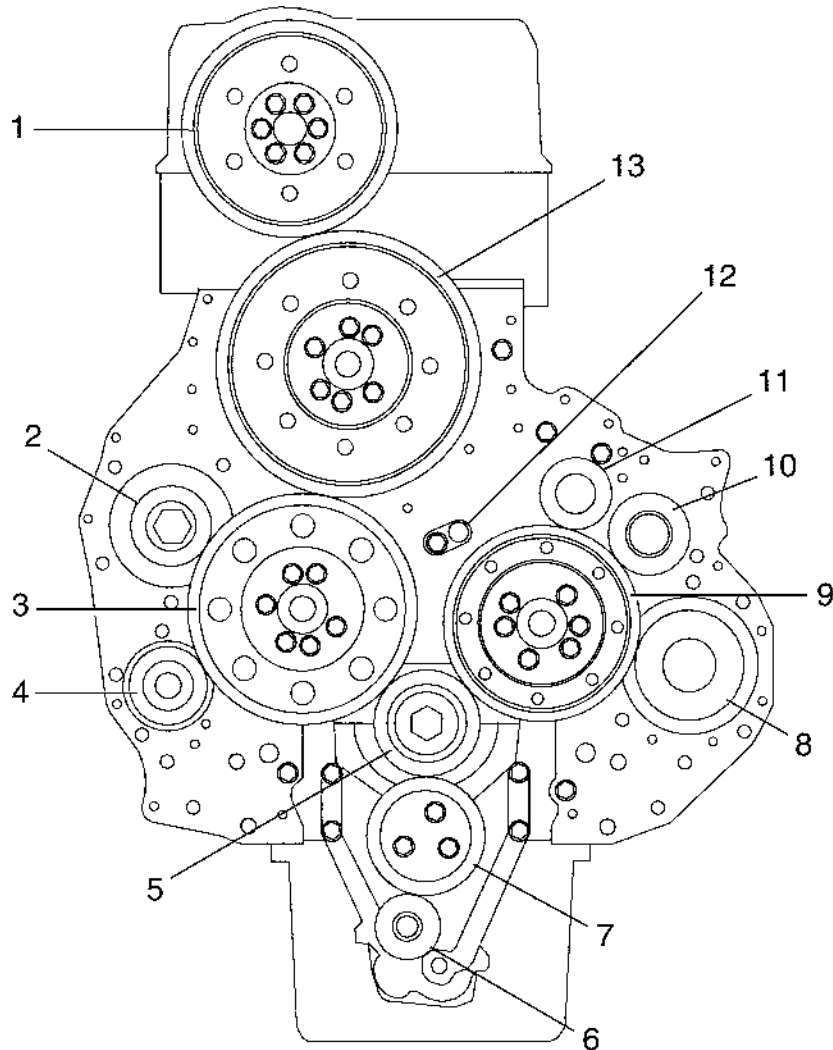
The camshaft has three cams per cylinder: one for the inlet valves, one for the exhaust valves and one for the unit injectors.



Timing drive

The timing drive on the TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE engines is located at the front of the engine on a 10 mm thick steel plate. All gears are helical. The intermediate gears (3, 7, 9, 13) are carried in bushes and pressure lubricated. Other lubrication is done via a nozzle (12).

Between the cylinder block and cylinder head is an **adjustable** intermediate gear (13). This gear must be adjusted after every service measure that affects the timing. It is important that the **correct flank clearance** is obtained between the upper and lower gears that mesh with the adjustable intermediate gear.



- | | | | |
|----|---------------------------|-----|--|
| 1. | Gear, camshaft (z=76) | 8. | Gear, hydraulic pump (z=39) |
| 2. | Gear, compressor (z=29) | 9. | Intermediate gear (z=71) |
| 3. | Intermediate gear (z=83) | 10. | Gear for drive belt and fuel pump (z=27) |
| 4. | Gear, coolant pump (z=27) | 11. | Gear, servo pump (z=23) |
| 5. | Gear, crankshaft (z=38) | 12. | Spray nozzle, gear lubrication |
| 6. | Gear, oil pump (z=23) | 13. | Intermediate gear, adjustable (z=97) |
| 7. | Intermediate gear (z=44) | | |

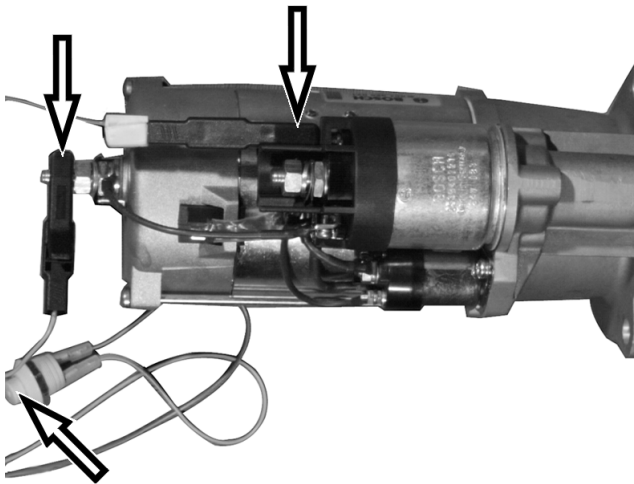
Instructions for running the starter motor

⚠ IMPORTANT! Make sure that the engine cannot start when it is turned over with the starter motor.

1

Make sure that the ignition switch is in the “0” position. If the ignition key is not used to start the engine, ensure that the switch supplying the engine with the start signal is in the “OFF” position.

2



Connect a switch between the ground terminal and the starter relay (see illustration).

NOTE: Do not run the starter motor for longer than 15 seconds at a time. Allow the batteries and starter motor to rest for 1 minute before trying to start the engine again.

3

Disconnect and remove the switch once you have finished running the starter motor.

Repair instructions

When work involves chemicals, fuel and lubricating oil

Important! Apply barrier cream to your hands and always use protective gloves when work involves oil, fuel and the like.

Continuous skin contact with engine oil dries out the skin and could be harmful.

Before lifting the engine

1

Turn off the battery current, remove the starter motor connections.

2

Unplug the engine wiring connectors.

3

Remove the exhaust pipe.

4

Close the fuel cocks.

5

Detach the fuel connections.

6

Disconnect the cables from the engine.

7

Undo the engine mounts and lift out the engine.

After lifting the engine

1

Clean the engine.



WARNING! Observe the following when using high-pressure equipment to clean the engine: Take great care to ensure that water does not enter engine components. When the high-pressure function is engaged, never direct the water at sealing arrangements like shaft seals, joints with gaskets, rubber hoses, etc. nor at electrical components.

2

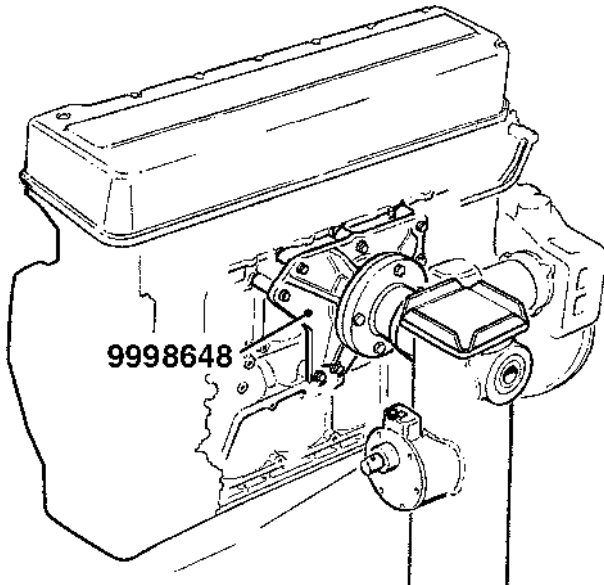
Pump out the engine oil (as needed).

Engine jig, attaching

Special tool: 9998648

Other special equipment: 9986485

1



Use engine jig 9998648 to secure the engine in engine stand 9986485.

2

The jig can be bolted to the left-hand side of the engine as shown in the above illustration.

NOTE: It is important to use the number of bolts indicated to ensure that the engine is fastened securely in position.

Use the bolts supplied with the jig.

Compression test

Unit injectors removed and fuel drained

Compression test can be performed two different ways, either using the diagnostics tool or manually employing the method described below. To perform a manual compression test, first drain the fuel system and then remove the rocker arm bridge and unit injectors.

NOTE: Fit protective sleeve 9998249 on the unit injectors so that they will not be exposed to impurities or damage.

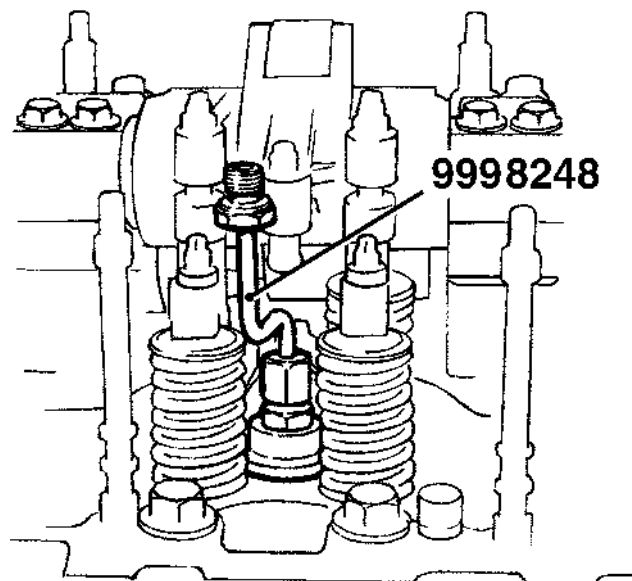
When performing a manual compression test on the engine, use 6 adapters (9998248) to avoid repeated removal and refitting of the rocker arm bridge and unit injectors as well as valve adjustment.

⚠ IMPORTANT! Make sure that the area around the unit injectors is clean before removing them.

Special tools: 9998248, 9998249

Other special equipment: 9988539

1



Fit all 6 adapters 9998248 in the cylinder head.

2

Oil the valve yokes, camshaft cams and rocker arm bridge.

3

Tighten the rocker arm bridge bolts successively so that the bridge does not bend or twist, see tightening diagram "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE". Then tighten the bolt until it fits against the camshaft cams. Then tighten according to the tightening diagram.

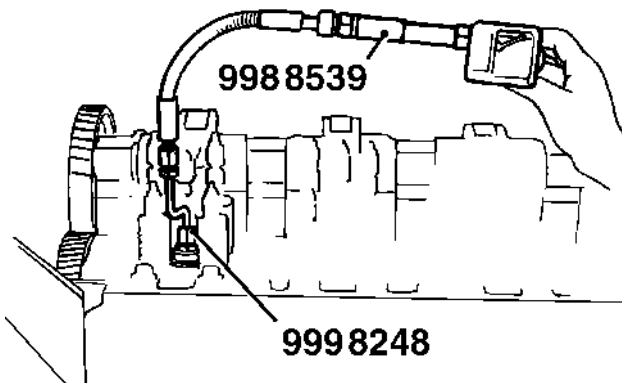
4

Check that the valve clearance of all valves is to specification.

5

Connect a switch to the starter motor. See "Instructions for running the starter motor".

6



Connect compression tester 9988539 to the first cylinder and perform the test using the switch.

7

Turn the engine over by means of the switch until the compression tester needle stops. Note the reading.

8

Perform the same test on the other cylinders.

9

If the results of the compression test are OK, refit the unit injectors and rocker arm bridge. Adjust the valve clearances and unit injectors.

10

Perform leakage and functionality checks.

Cylinder head, removing

⚠ IMPORTANT! Strict cleanliness must be observed when working on the cylinder head.

Dirt particles in the fuel passages could cause breakdown or malfunction of the unit injectors.

Special tools: 9993590, 9996966, 9998249, 9998251, 9998255, 9998264, 9998511, 9998629

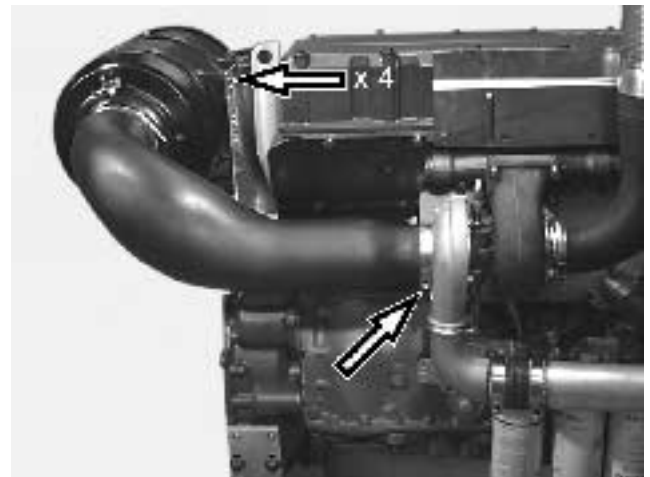
Prior conditions:

Fuel and coolant drained. See instructions in the Service Manual.

1

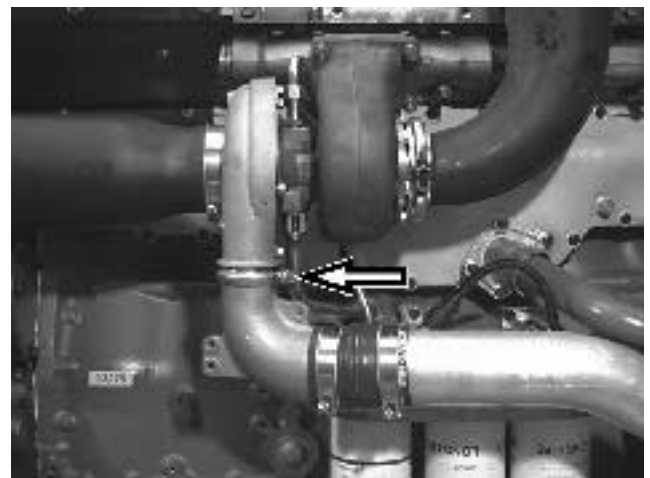
Turn off the power by means of the main switch (switches) and check that no current is supplied to the engine.

2

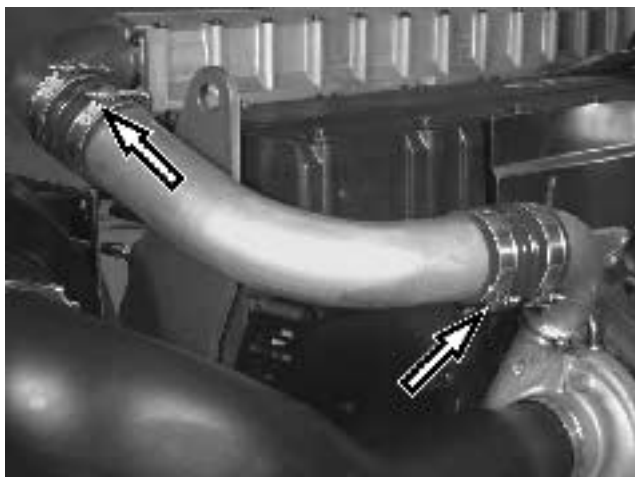


Undo the clamp at the turbocharger and remove the air cleaner from the bracket.

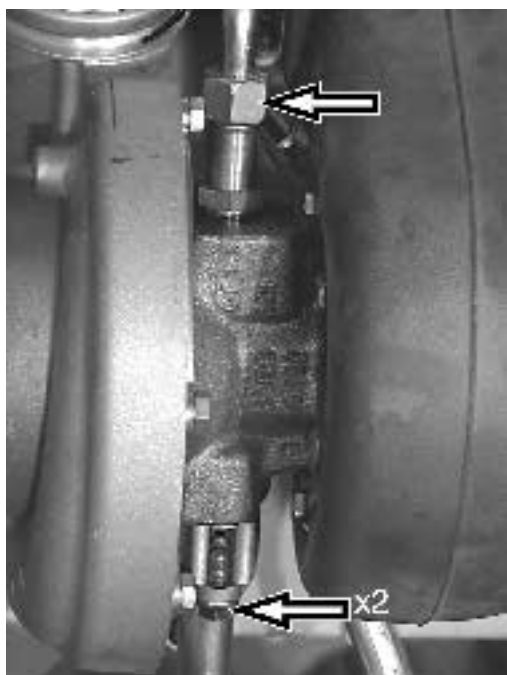
3 (TAD)



Remove the lower charge air pipe by the turbocharger.

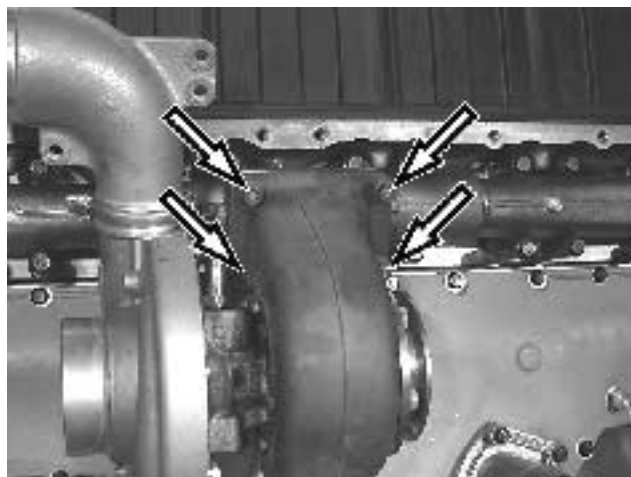
3 (TWD)

Remove the charge air pipe from between the turbocharger and the charge air cooler.

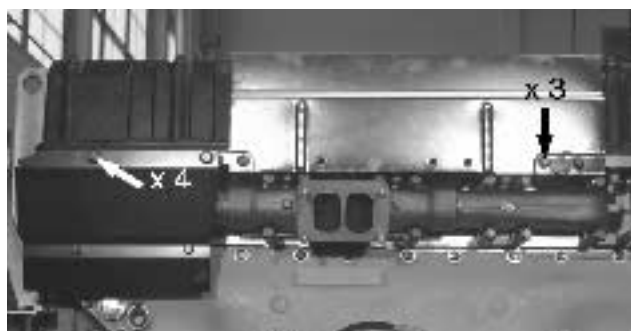
4

Remove the oil pipes from the turbocharger.

NOTE: Exercise care so that dirt particles do not enter the connections to the turbocharger.

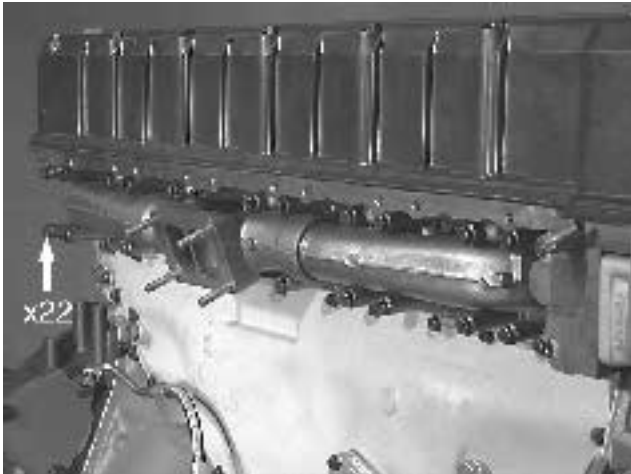
5

Remove the turbocharger.

6

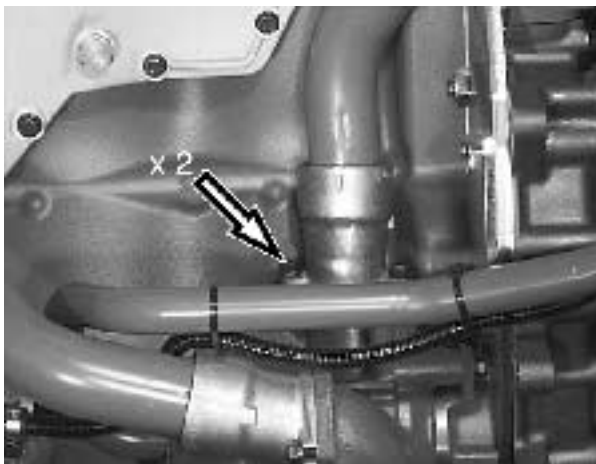
Remove the rear protective plate and front heat shield from the cylinder head.

7



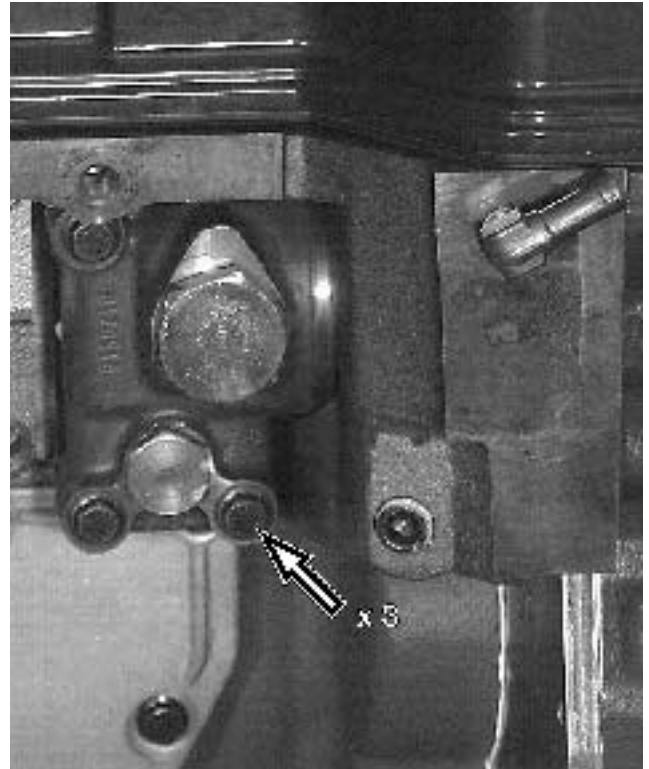
Remove the exhaust manifold.

8



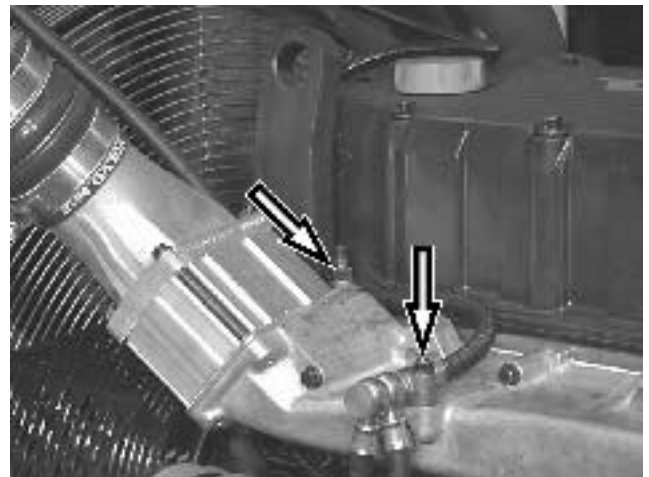
Remove the water pipe between the thermostat housing and coolant pump.

9

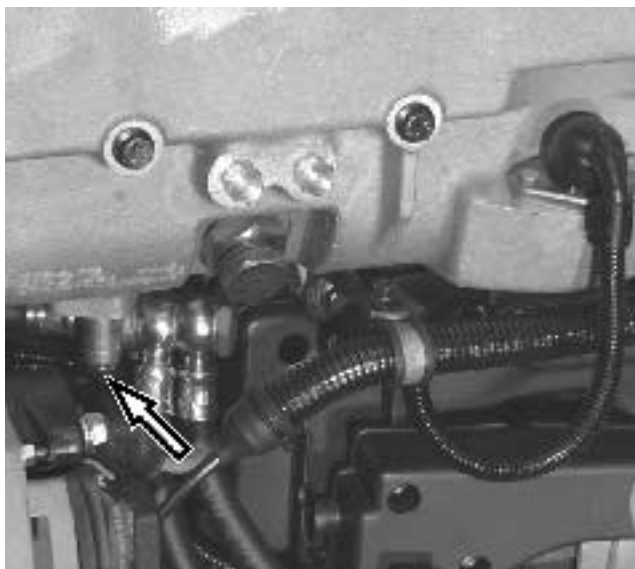


Remove the thermostat housing and take out the thermostat.

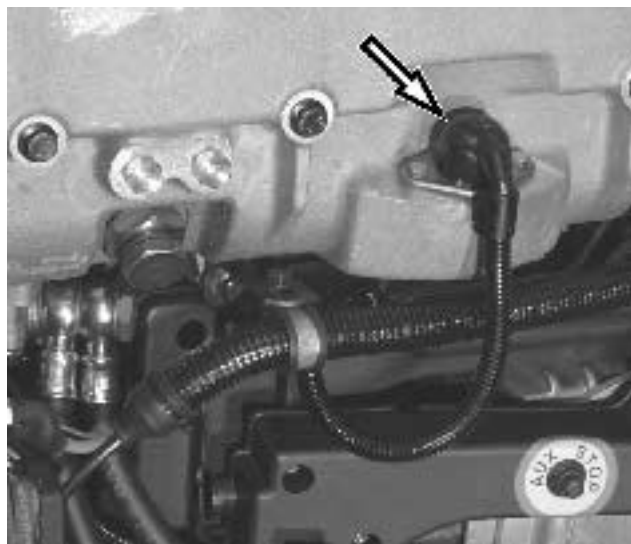
10 (TAD)



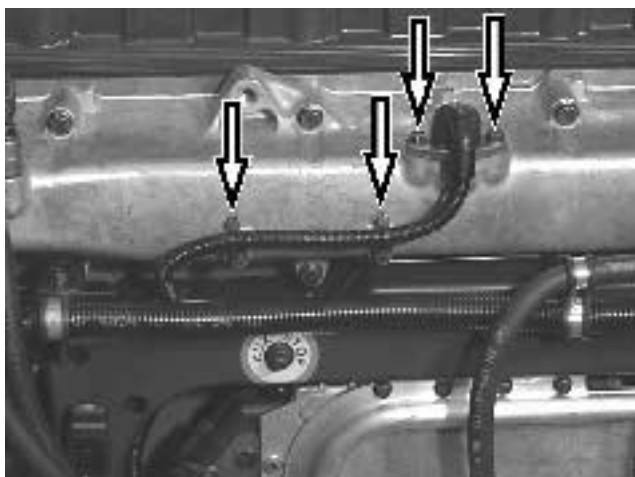
Remove the overflow valve and fuel connection.

10 (TWD)

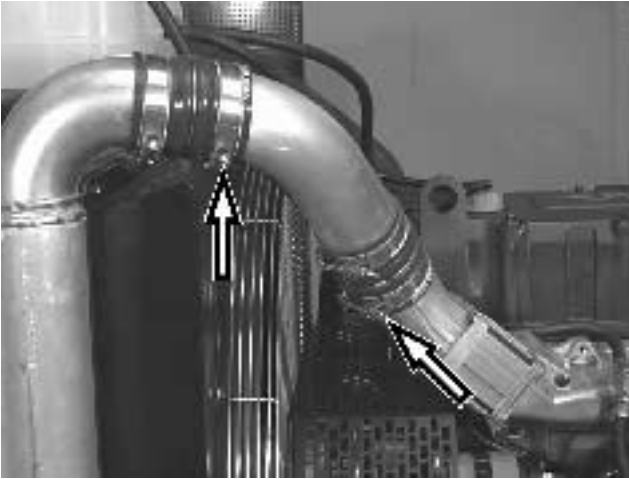
Remove the overflow valve.

11 (TWD)

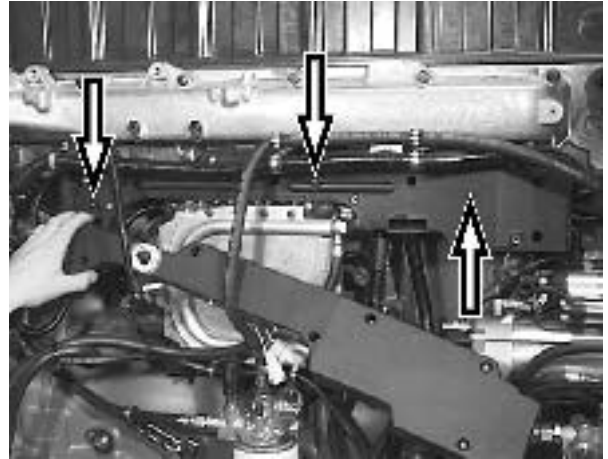
Remove the charge air temperature sensor/charge pressure sensor from the inlet manifold.

11 (TAD)

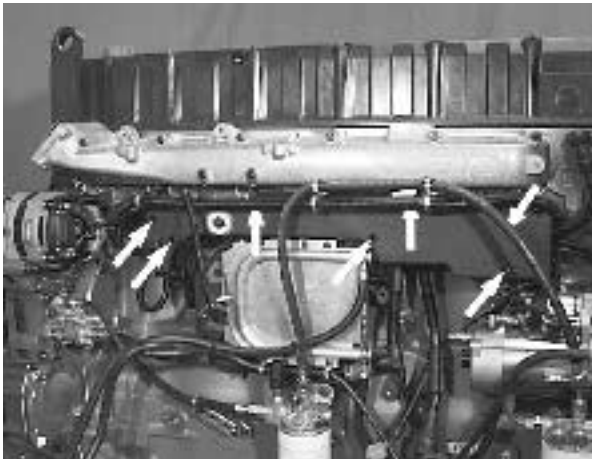
Remove the strap and remove the charge air temperature sensor/charge pressure sensor from the inlet manifold.

12 (TAD)

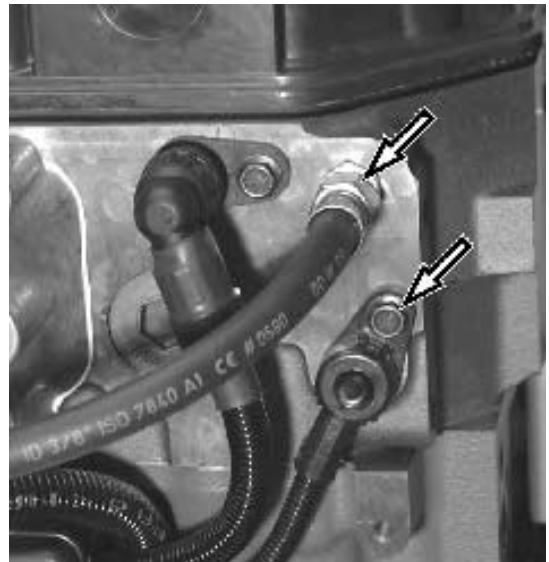
Remove the charge air pipe between the inlet manifold and charge air cooler.

14

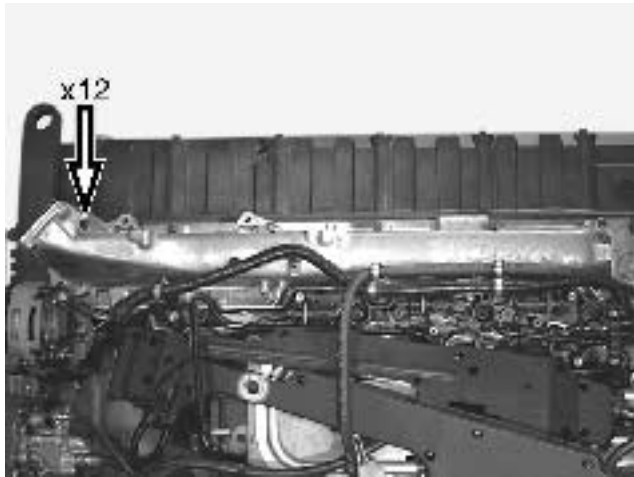
Remove the intermediate bracket.

15**13**

Remove the cover from the wiring box.

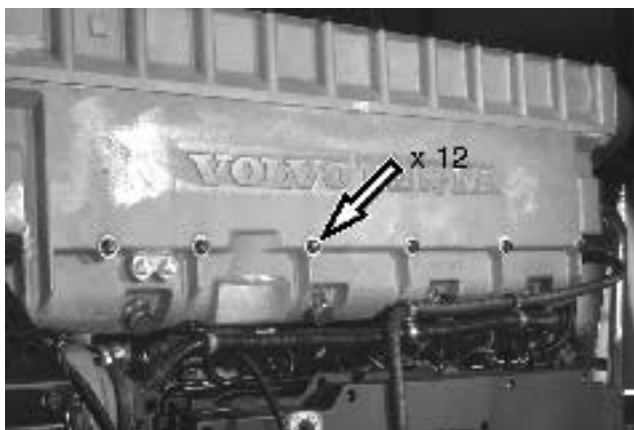


Remove the fuel connection and temperature sensor.

16 (TAD)

Remove the inlet manifold.

NOTE: The inlet manifold may be difficult to remove because the sealing compound may have hardened.

16 (TWD)

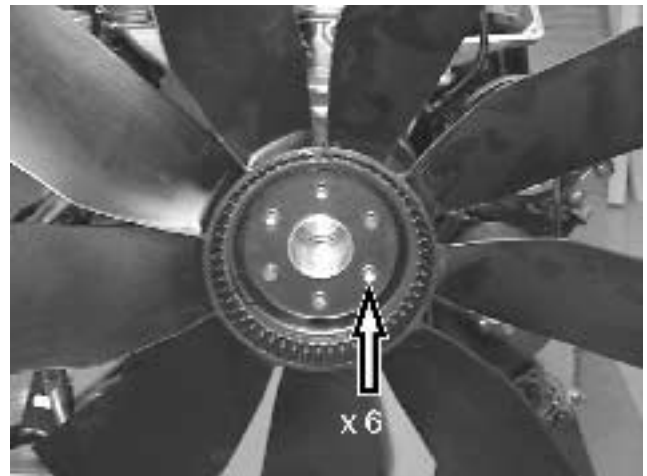
Remove the inlet manifold.

17

Remove the radiator assembly, see "Group 26, Radiator element, changing".

18

Remove the protective plates round the drive belts.

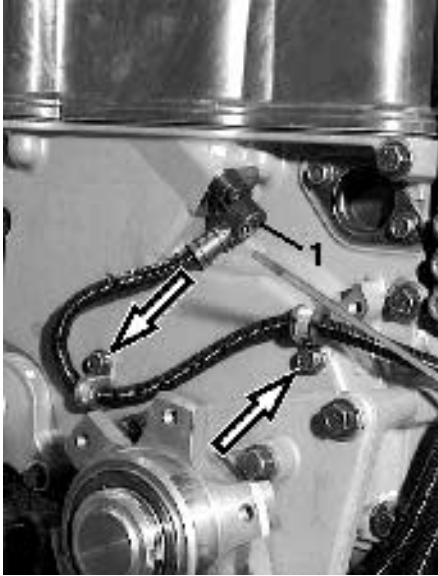
19**3 (TWD)**

Remove the radiator fan (six studs) and the drive belt. See "Group 26, Drive belts, changing".



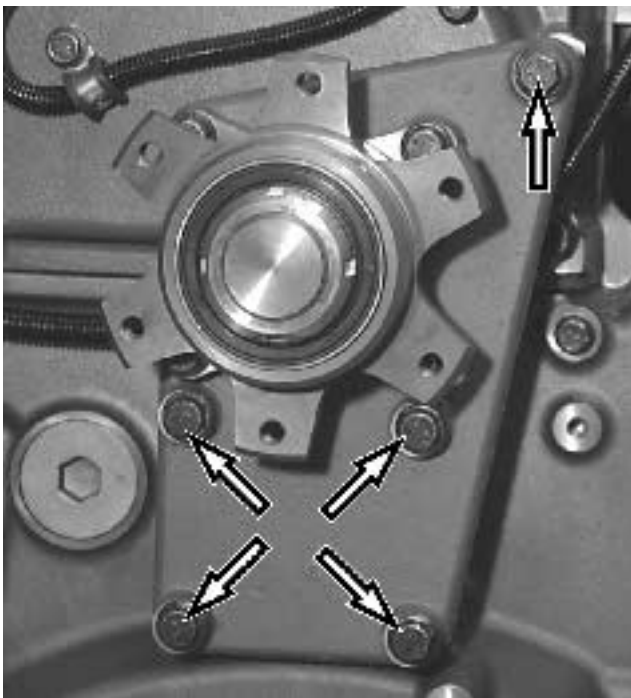
Remove the spacer and pulley.

21



Remove the clamps and camshaft position sensor (1).

22

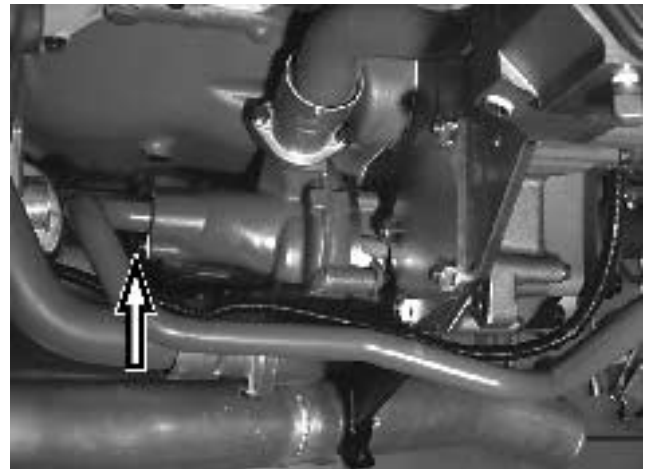


Remove the radiator fan drive.

23

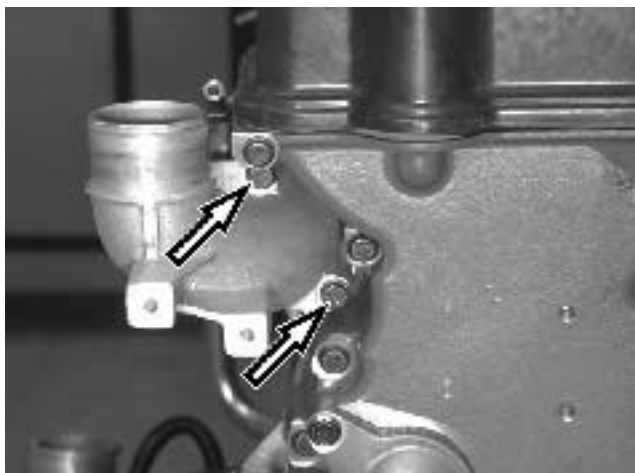
Undo the clamps and pull away the hose between the pipes to the crankcase breather.

24



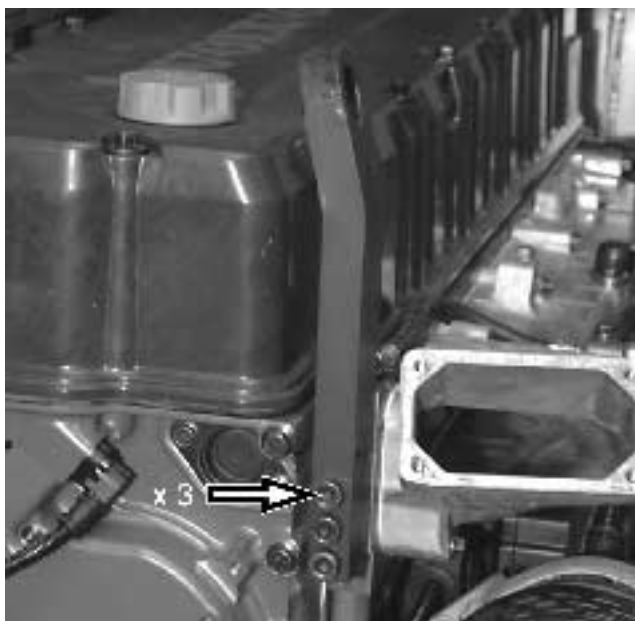
Detach the water pipe from the coolant pump and radiator hose connection.

25



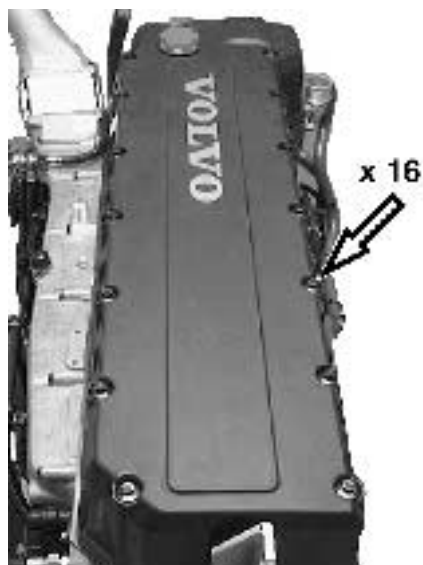
Remove the upper radiator hose connection from the cylinder head.

26



Remove the front engine lifting bracket.

27



Remove the valve cover.

NOTE: Do **not** use air-assisted tools when removing the valve cover as this could damage the unit injector wiring harness.

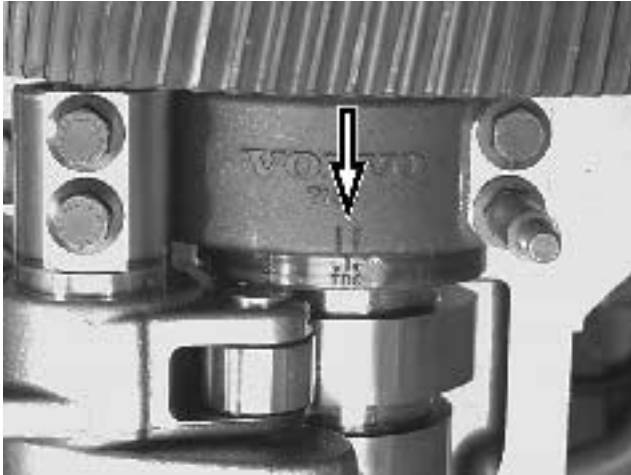
28



Fit turning tool 9993590 in the flywheel housing.

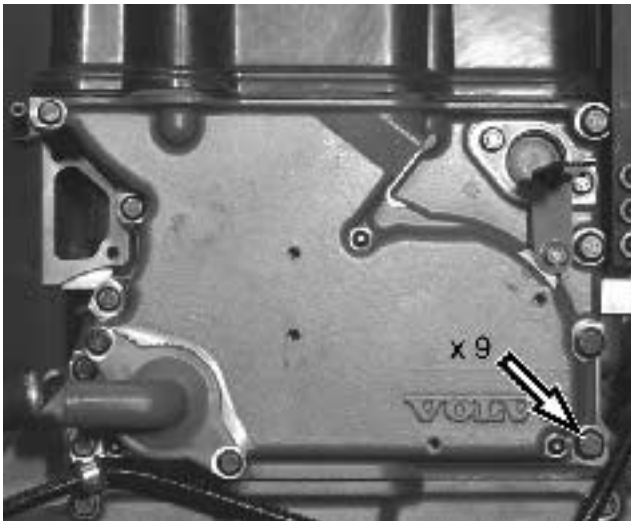
NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the cover.

29



Rotate the flywheel until the piston in cylinder 1 is at top dead center 0° on the flywheel and the camshaft marking (TDC) is between the marks on the bearing cap.

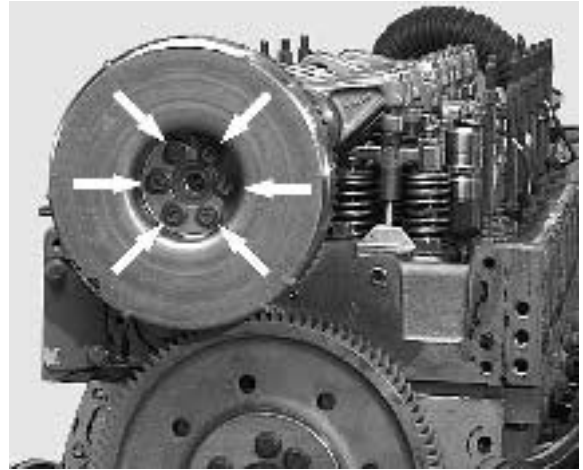
30



Remove the upper timing cover.

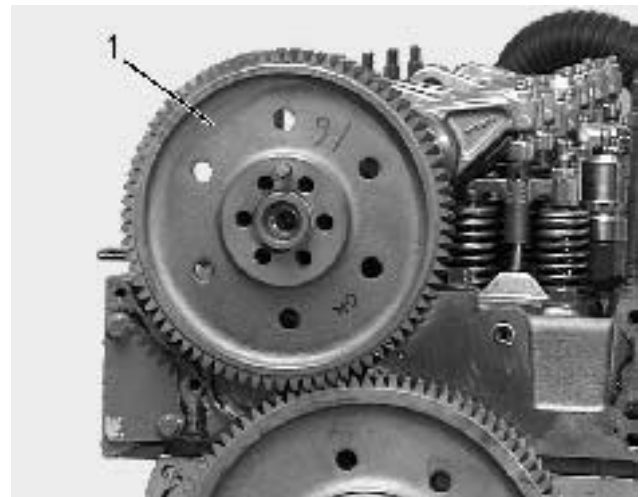
NOTE: One of the upper timing cover retaining bolts also secures the radiator fan drive.

31



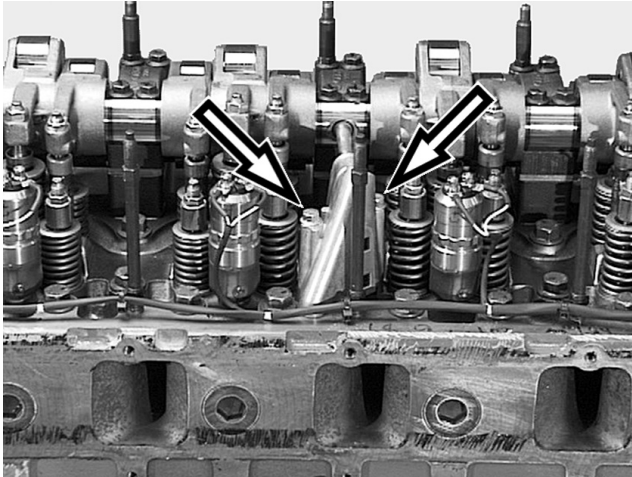
Remove the toothed wheel.

32



Remove the camshaft gear (1). Use a puller if necessary.

33



Remove the supply of lubricating oil for the rocker arm bridge.

34



Undo the rocker arm bridge retaining bolts evenly over the entire bridge to avoid uneven stress.

Lift away the rocker arm bridge using lifting tool 9998255.

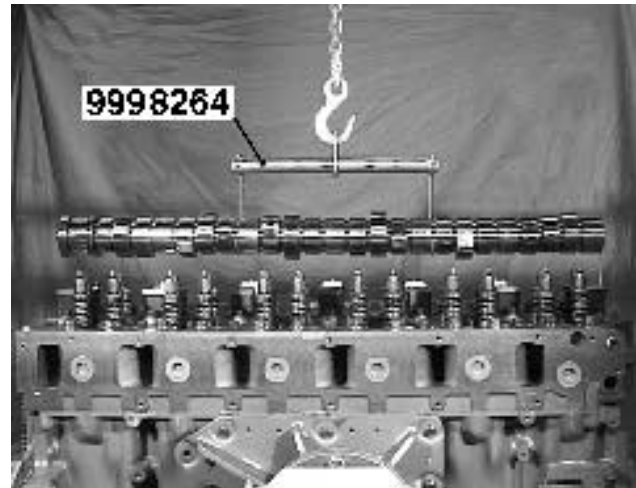
⚠ IMPORTANT! To avoid injury and material damage, the rocker arm bridge should be lifted away by two persons if no lifting device is available. The rocker arm bridge weighs about 27 kg (60 lbs).

35

Check that the camshaft bearing caps are factory marked 1-7 against the relevant bearing bracket. Loosen the camshaft bearing caps by tapping them carefully with a plastic mallet.

NOTE: The camshaft bearing caps are held in place with guide pins.

36

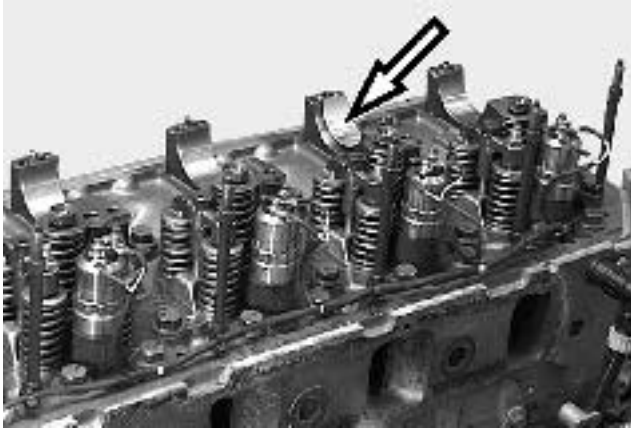


Lift the camshaft away using lifting tool 9998264.

⚠ WARNING! Bear in mind that the camshaft cams are extremely sharp.

⚠ IMPORTANT! To avoid injury and material damage the camshaft should be lifted away by at least two persons if no lifting device is available. The camshaft weighs about 35 kg (77 lbs).

37



Take out the lower bearing halves by tapping the bearing brackets carefully with a plastic mallet.

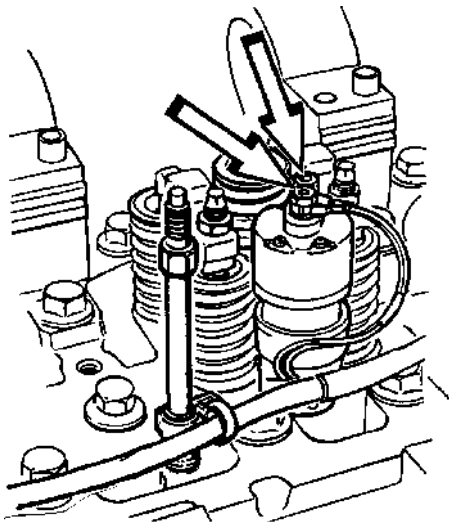
Remove the bearing brackets and place them in the right order together with their respective camshaft bearing caps, bearing halves and bolts.

NOTE: The camshaft bearing brackets are held in place with guide pins.

38

Lift away the valve yokes between the inlet valves and exhaust valves for all cylinders. Place them in the right order for the respective cylinder.

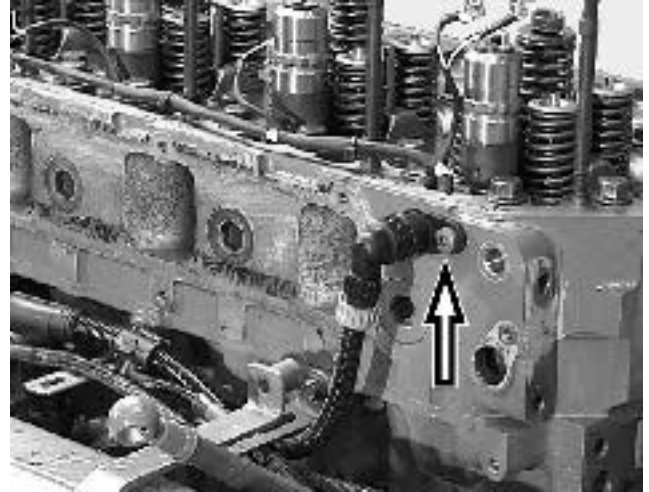
39



Detach the electrical connections from the unit injectors and cut the straps on the wiring.

⚠ IMPORTANT! Exercise care when handling the unit injectors as they can easily sustain damage if the nuts are cross-threaded or tightened too hard.

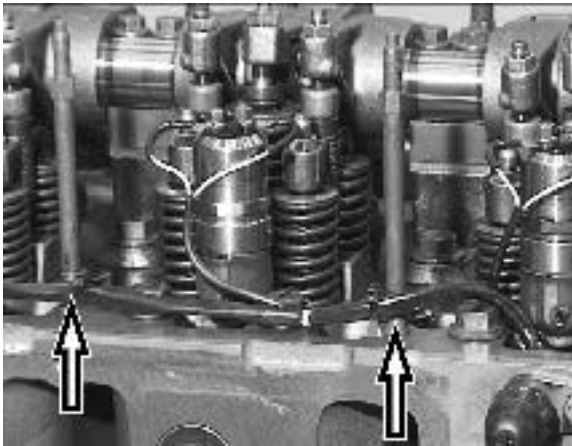
40



Remove the wiring bracket on the cylinder head and carefully withdraw the unit injector wiring harness.

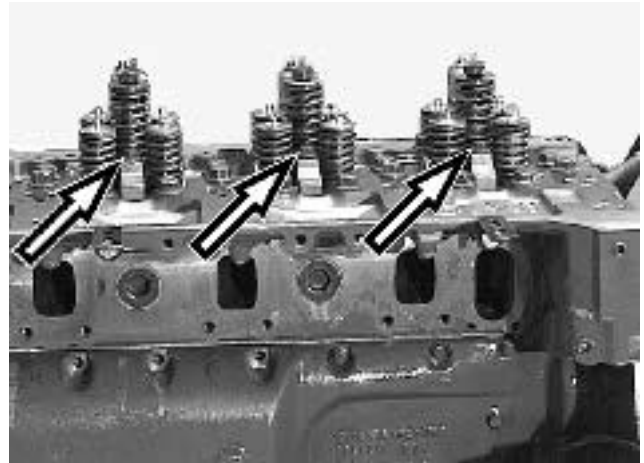
NOTE! The wiring harness cannot be taken apart at the wiring bracket but must be carefully withdrawn as a complete unit.

41



Remove all studs.

42



Remove the retaining yoke bolts on all unit injectors.

43

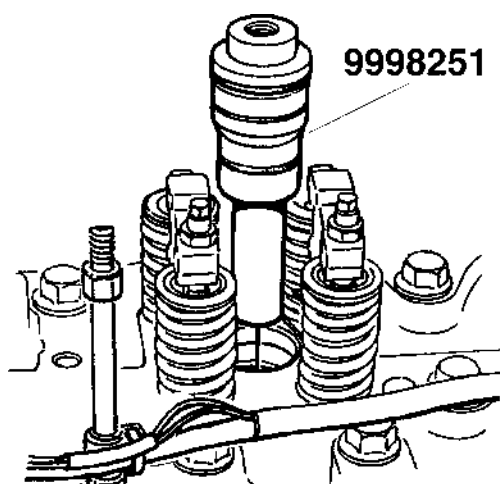


Remove the unit injectors one at a time using tool 9998511. Carefully prise under the unit injector until it loosens. Fit protective sleeve 9998249 on the unit injectors.

⚠ IMPORTANT! Do NOT remove all unit injectors at the same time but remove them one by one as each protective plug is fitted in place.

Place the unit injectors where they cannot be damaged.

44



Fit protective plug 9998251 in the hole for the unit injector in the cylinder head.

⚠ IMPORTANT! Utmost cleanliness is demanded.

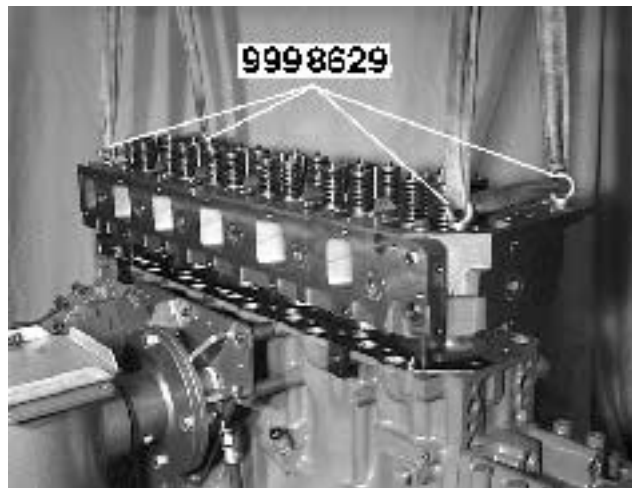
45

Remove all cylinder head bolts.

46

Wipe up the engine oil that has collected in the “bowls” under the camshaft. The oil could otherwise run down into the coolant passages when the cylinder head is lifted away.

47



Fit four lifting eyes 9998629 and attach lifting straps. Carefully lift away the cylinder head.

⚠ WARNING! At least four persons should carefully lift it away if no lifting device is available. The cylinder head weighs about 130 kg (287 lbs).

48

Fit press tool 9996966 on the cylinder liners so that they are not dislodged from their positions if the crankshaft is rotated.

49

Remove the seals.

Thoroughly clean the contact surface on the cylinder block.



IMPORTANT! Make sure that no residual sealant or dirt particles can enter the coolant and oil passages.

Cylinder head, fitting/removing jig 885316

When work does not include servicing of the cylinder head or cylinder block, jig 885316 can be used when replacing valves, pistons, cylinder head gaskets, etc. When performing this work, the inlet manifold and camshaft can remain in place.

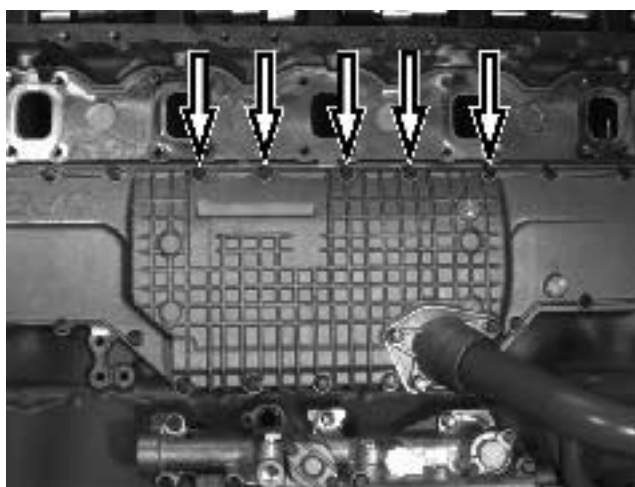
Special tools: 885316, 9998629

1

Remove the engine components necessary to be able to fit the jig.

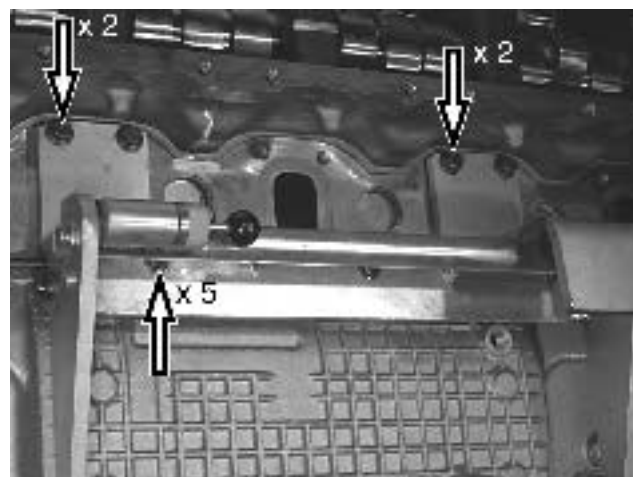
See "Cylinder head, removing" for instructions.

2



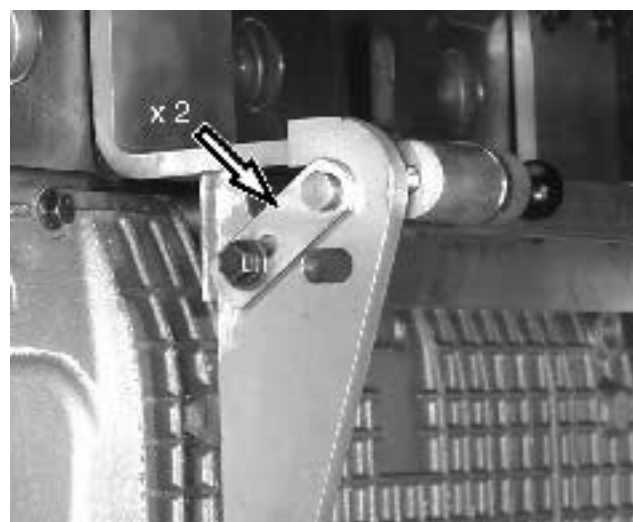
Remove the five bolts on the cover of the oil cooler.

3



Secure the bottom of jig 885316 on the oil cooler cover (5). Secure the top of jig 885316 to the exhaust ports on cylinders 2 and 4.

4



Fit the bolts and brackets on both sides of the jig.

NOTE: The brackets work as a stop, so it is important that they are fitted correctly.

6



Fit lifting eye 9998629 to the center of the cylinder head.

7



Put a crowbar or the like in lifting eye 9998629. Use the crowbar as a lever to carefully lift up the cylinder head.



WARNING! Risk of getting pinched. Carefully check that the safety catch works so the cylinder head cannot fall back. The cylinder head weighs about 130 kg (287 lbs).

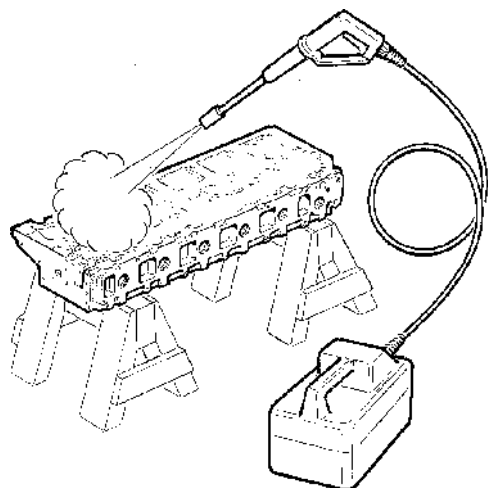
8

Pull back the catch on the jig and carefully lower the cylinder head.

9

Remove jig 885316 and lifting eye 9998629 from the cylinder head. Refit all removed engine components in reverse order. See instructions "Cylinder head, fitting".

Cylinder head, fitting

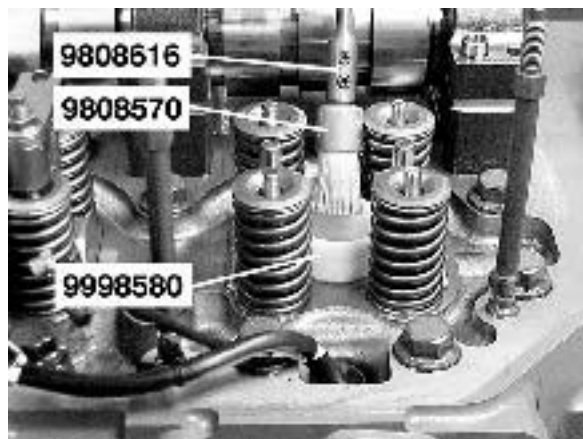


Dirt particles and water should be sucked out of the fuel passages after cleaning.

⚠ IMPORTANT! The cylinder head must be thoroughly cleaned inside and out before it is fitted back in place. Dirt particles in the fuel passages could cause a breakdown or malfunction of the unit injectors.

Special tools: 9993590, 9998251, 9998255, 9998601, 9998602, 9998624, 9998264, 9998599, 9998628, 9998629, 9996966, 9999683, 9999696

1



If necessary, clean the copper sleeves of the unit injectors using cleaning kit 9998599 (the tools in the illustration are included in the cleaning kit) before lifting the cylinder head into position on the cylinder block.

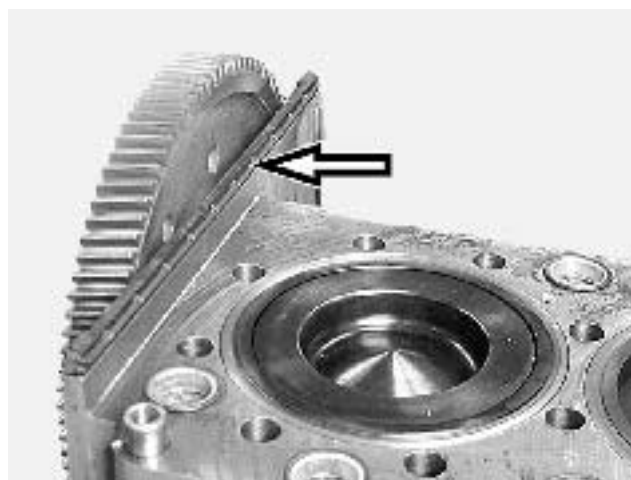
See "Group 23, Unit injectors, changing".

2



Remove press tool 9996966 for the cylinder liners.

3

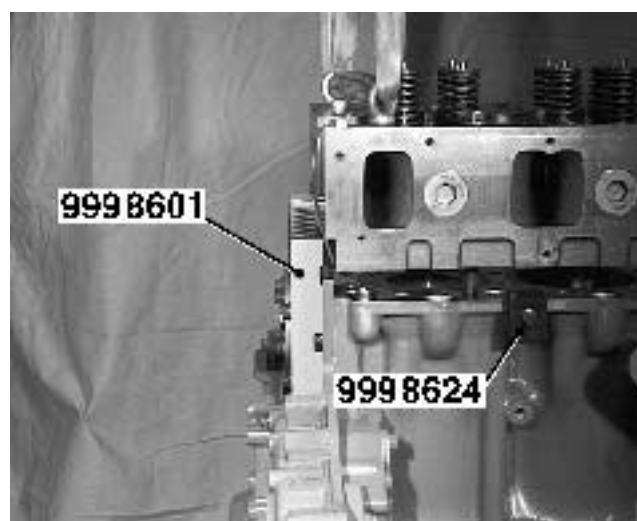
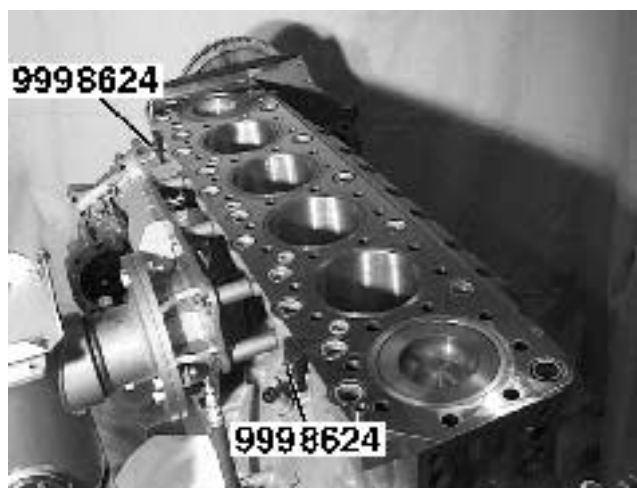


Fit new seals and a new cylinder gasket.

Change the timing plate gasket.

NOTE: Carefully check that all sealing rings are properly fitted and not skewed or out of position.

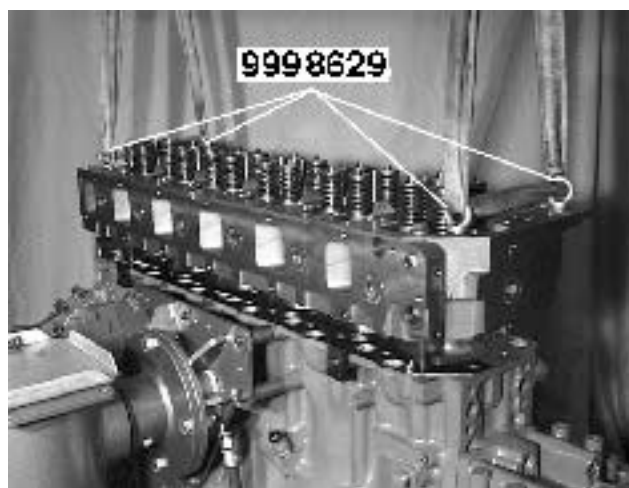
4



Fit the securing tools as shown in the illustration.

⚠ IMPORTANT! Before fitting the tools:
Check the flatness of the tools by placing them on a flat surface. If the tools do not lie flat against the cylinder head and cylinder block, the cylinder head mounting will be faulty, resulting in the risk of serious engine damage. Clean off all paint and silicone from the contact surfaces of the tools.

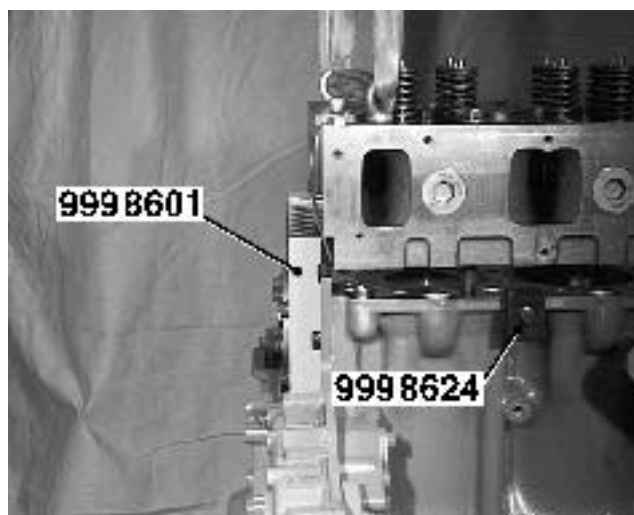
5



Fit four lifting eyes 9998629 and attach lifting straps. Carefully lift the cylinder head into place.

⚠ WARNING! If no lifting device is available, at least four persons should carefully lift it and one person guide it into the correct position. The cylinder head weighs about 130 kg (287 lbs).

6



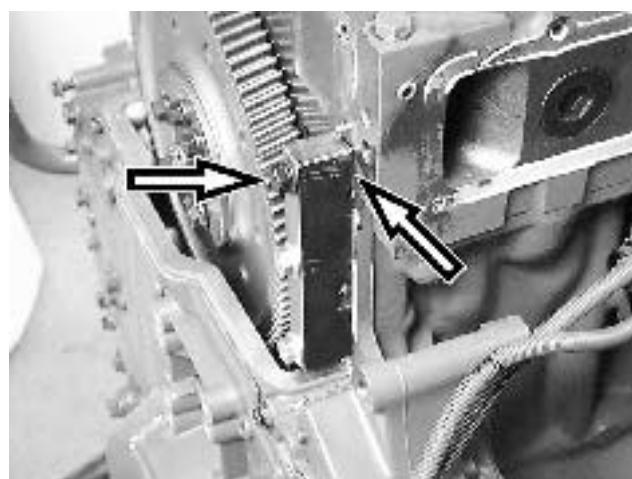
Check that the gasket between the cylinder head and timing plate is correctly positioned.

Lower the cylinder head until the guide pins for the cylinder head gasket in the block guide the cylinder head straight down. Do not lower the cylinder head all the way down but leave it suspended a few inches above the surface of the block.

Press the cylinder head diagonally forward by hand so that it is fixed in place by the securing tools. Lower the cylinder head onto the block.

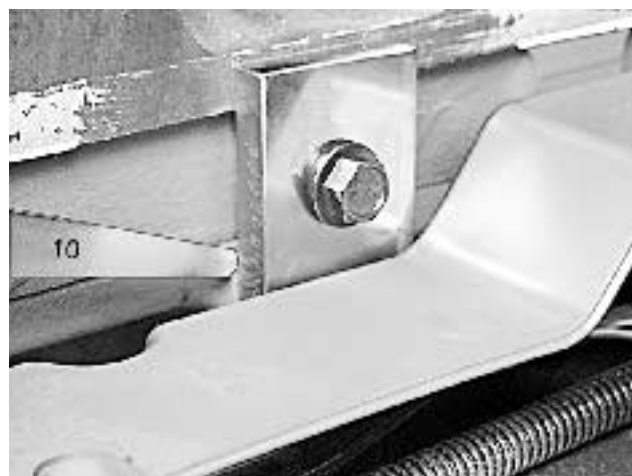
NOTE: Be careful when moving the cylinder head so that gaskets/seals are not damaged.

7



Insert an M10x50 mm bolt in the upper hole of the securing tool at the timing plate to ensure that the cylinder head abuts the tool.

8



Check that a 0.10 mm feeler gauge cannot be inserted between the securing tool and the cylinder head.

9

Remove the lifting tools.

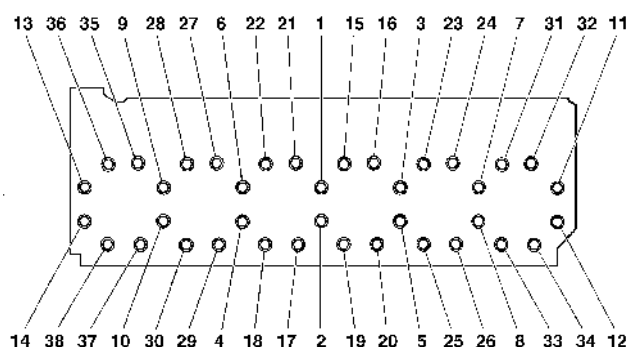
10

Dip the cylinder head bolts in corrosion inhibitor, part no. 282036. Place them in a net or the like so that surplus corrosion inhibitor can run off.

11

Fit the cylinder head bolts.

Tighten according to the tightening diagram.



Stage 1	60±10 Nm (6.0±1.0)
Stage 2 (control tightening)	60±10 Nm (6.0±1.0)
Stage 3 angle tightening	90°±5°
Stage 4 angle tightening	90°±5°

Instructions are also available in "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

NOTE: A useful tip is to write the order of tightening on the cylinder head with a marker pen.

12

Carefully pull the wiring for the unit injectors into the cylinder head. Tighten the wiring bracket on the cylinder head.

13

Take protective plugs 9998251 out of the unit injector holes.



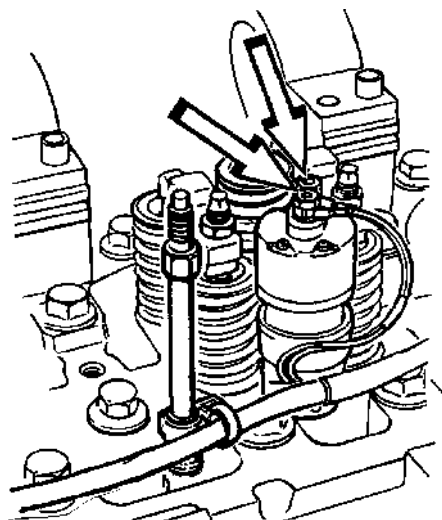
IMPORTANT! Do NOT remove all protective plugs at the same time but remove them one by one as each unit injector is fitted in place.

14

Fit new sealing rings on the unit injectors. Lubricate the sealing rings with engine oil. Fit the unit injectors and press them down forcefully until they reach the bottom; center them so that they do not touch the valve springs.

Tighten the unit injectors to the specified torque. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

Note: Unit injector tightening torques are **different** depending on whether or not the copper sleeve is new.

15

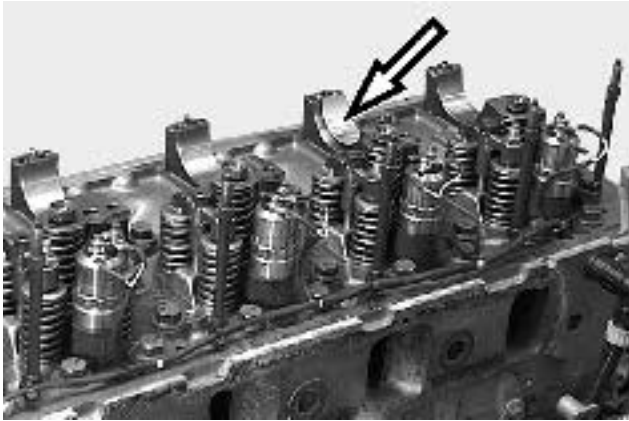
Connect the electric leads to the unit injectors.

NOTE: Tighten the nuts to a torque of max. 1.5 Nm.



IMPORTANT! Exercise great care when handling the unit injectors as they can easily sustain damage if the nuts are cross-threaded or tightened too hard. If the bolts break, the entire unit injector will have to be replaced.

16



NOTE: If a new cylinder head is fitted, the bearing brackets supplied with it must be used.

Fit new camshaft bearing shells in the bearing brackets and caps as necessary. Make sure that bearings of the correct size are used and that they are fitted correctly in their seats.

17

Lubricate the bearing surfaces with engine oil.

18



Carefully lift the camshaft into position using lifting tool 9998264.

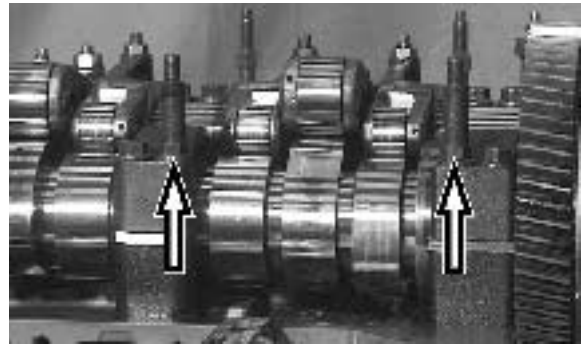


WARNING! Bear in mind that the camshaft cams are extremely sharp.



IMPORTANT! To avoid injury and material damage, the camshaft should be lifted away by at least two persons if no lifting device is available. The camshaft weighs about 35 kg (77 lbs).

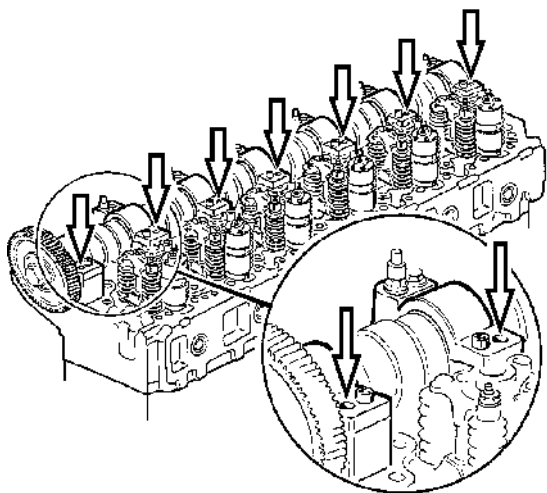
19



NOTE: See the location of the bearing cap bolts at far right. Fit the remaining bolts as on the bearing cap to the left (see illustration).

Fit the bearing caps on the respective bearing brackets. Screw in the bolts but do not tighten them.

20



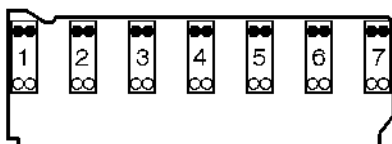
Insert 7 bolts (M10 x 90 mm) in the holes for the rocker arm bridge having no guide sleeves.

Tighten to M10 standard torque.

21

1.

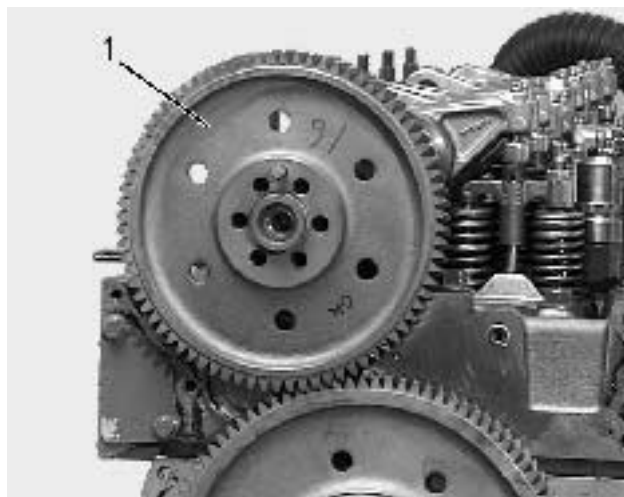
$15 \pm 5 \text{ Nm}$
 $+ 90^\circ \pm 5^\circ$



Tighten as per stage 1.

NOTE: Tighten one bearing cap at a time, checking that the camshaft can rotate freely. If it offers resistance, check the bearing cap that was last tightened.

22

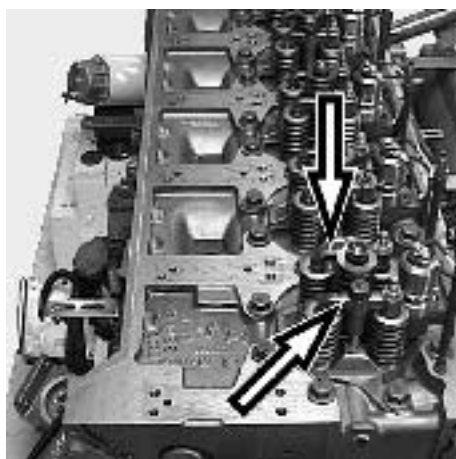


Fit the camshaft gear (1).

23

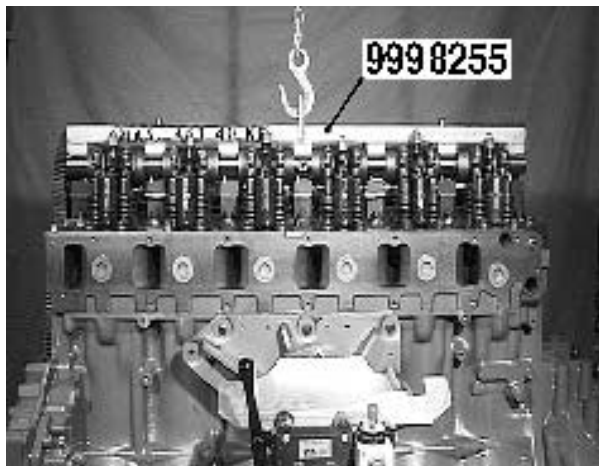
Check and adjust the flank clearance, see "Timing gear, changing".

24



Fit the valve yokes between the inlet valves and exhaust valves for all cylinders.

25



Remove the extra bolts that were fitted instead of the rocker arm bridge bolts.

Oil the valve yokes and camshaft cams with engine oil.

Lift the rocker arm bridge into place using lifting tool 9998255. Check that the valve yokes and rocker arms are correctly positioned relative to each other.

! IMPORTANT! To avoid injury and material damage, the rocker arm bridge should be lifted away by at least two persons if no lifting device is available. The rocker arm bridge weighs about 27 kg (60 lbs).

26



NOTE: Remove all adjusting screws for the valves and unit injector before fitting the rocker arm bridge.

Tighten the rocker arm bridge bolts by hand.

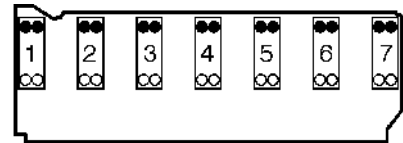
Tighten the retaining bolts for the rocker arm bridge and camshaft bearing caps to the torque specified in the tightening diagram.

NOTE: The tightening in stage 2 must be done gradually to ensure that the rocker arm shaft bottoms against the bearing housing without the shaft bending.

NOTE: In stage 4, the marked bolts are removed before stage 5 is performed. If the rocker arm shaft has been loosened or removed, only the bolts holding the shaft should be tightened as in the diagram when refitting.

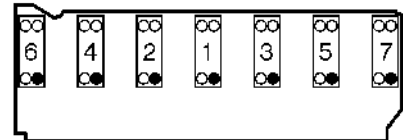
1.

$15 \pm 5 \text{ Nm}$
 $+ 90^\circ \pm 5^\circ$



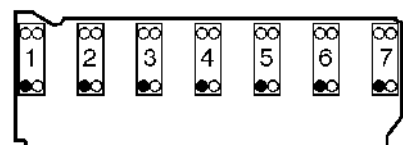
2.

$60 \pm 5 \text{ Nm}$



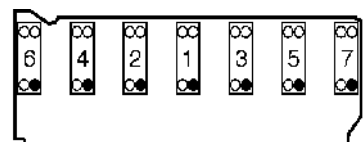
3.

$15 \pm 5 \text{ Nm}$
 $+ 120^\circ \pm 5^\circ$



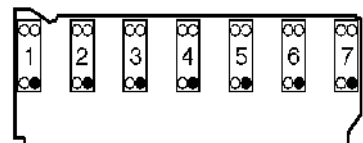
4.

$60 \rightarrow 0 \text{ Nm}$

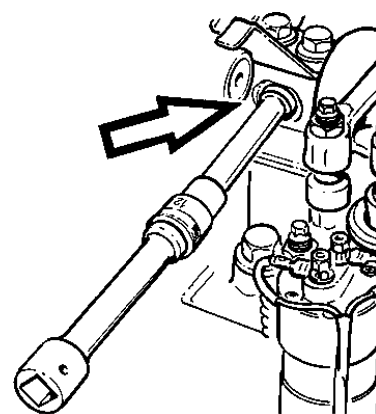


5.

$15 \pm 5 \text{ Nm}$
 $+ 120^\circ \pm 5^\circ$



27



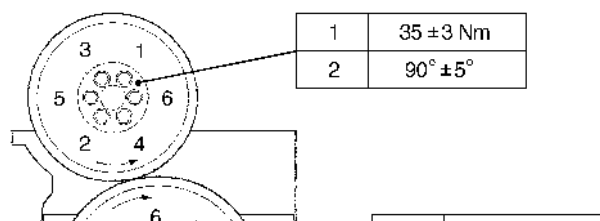
Mount the oil pipe for the rocker arm shaft. Wipe all oil off the oil pipe; making sure it is completely dry. Oil the hole in the rocker arm bridge.

Use a 1/2" short extension bar and a 12 mm socket. Insert the pipe in the socket and fit a new seal on the other end of the pipe. Press the pipe into the rocker arm bridge. Check that the sealing ring is correctly positioned.

28

Adjust the valves and unit injectors. See "Valves and unit injectors, adjusting".

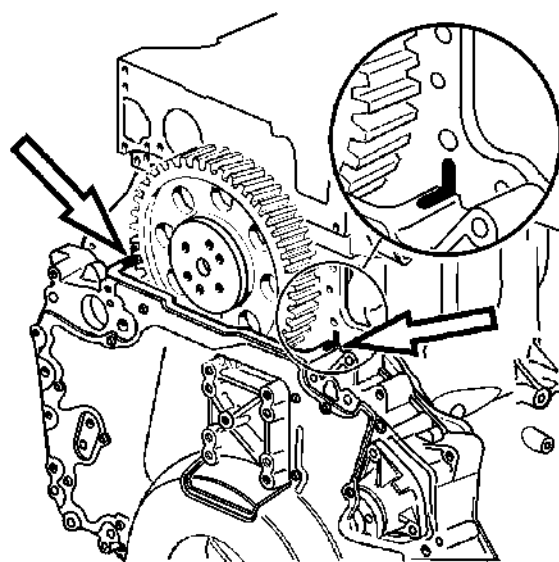
29



Fit the toothed wheel and tighten according to the tightening diagram above.

⚠ IMPORTANT! If the toothed wheel or any of its teeth are damaged or deformed, the toothed wheel must be replaced. The same applies if any of the holes for the toothed wheel retaining bolts are damaged.

30



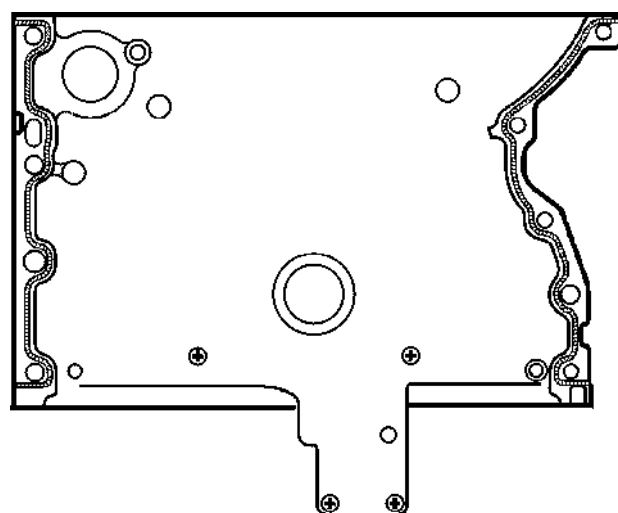
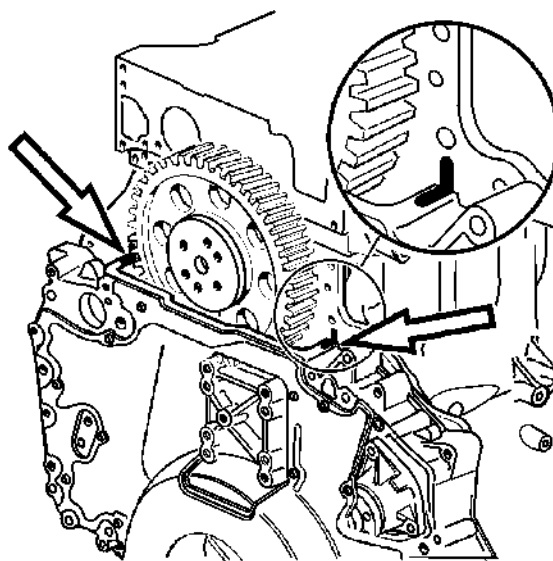
Clean the lower timing cover and apply sealant, part no. 1161231-4. Fit the lower timing cover in place.

NOTE: The timing cover must be fitted within 20 minutes of applying the sealant.

31

Clean the upper timing cover and the contact surfaces.

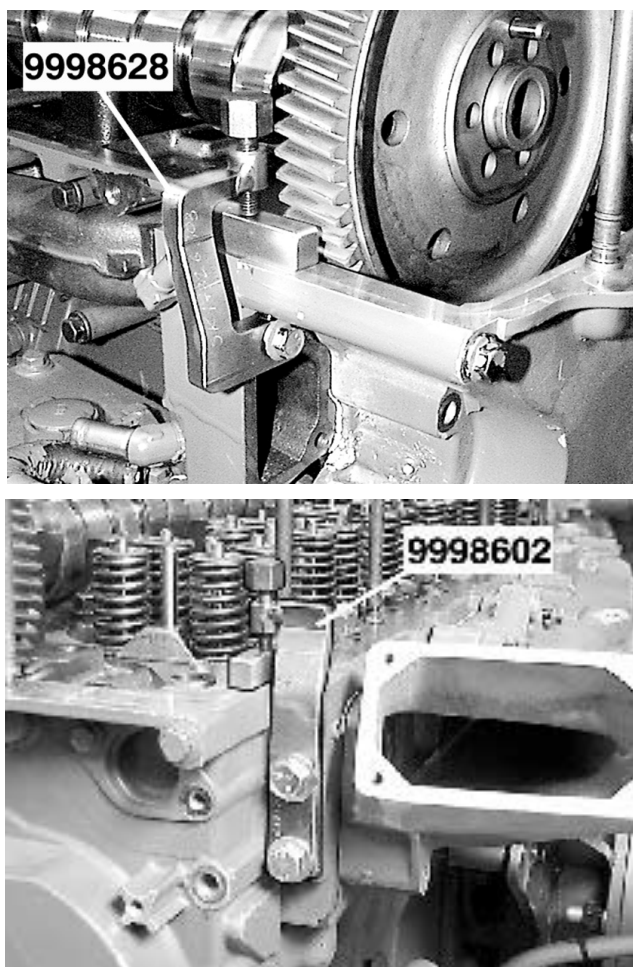
32



Apply a 2 mm thick bead (see illustration) of sealant, part no. 1161231-4, to the timing cover and in the corners between the lower timing cover and the timing plate.

NOTE: The timing cover must be fitted within 20 minutes of applying the sealant.

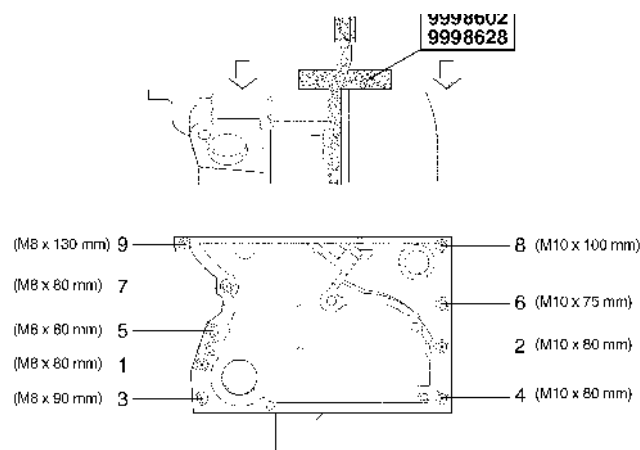
33



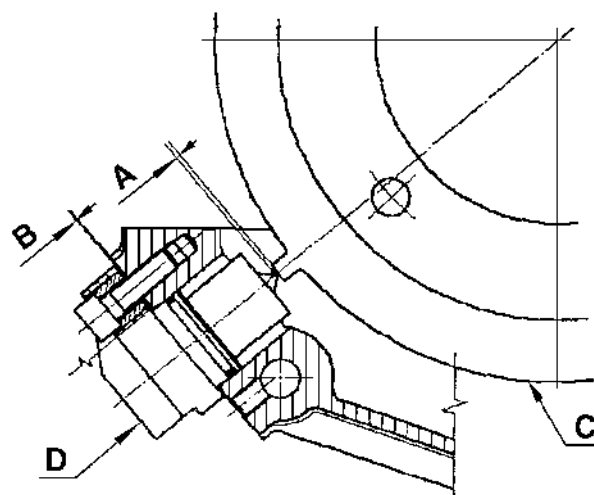
Fit the upper timing cover in place.

Insert the bolts in the slotted holes in the cover. Screw the bolts down but do not tighten them. Fit press tools 9998602 and 9998628. Screw the tools down so that the sealing surface of the valve cover against the timing cover is level with the sealing surface on the cylinder head. Fit the other bolts and tighten to the specified torque.

NOTE: Leave the press tools in place. Allow the sealant to solidify for about 30 minutes. Do not forget that one of the bolts also secures the radiator fan drive.



34



A = clearance mm

B = shim

C = toothed wheel

D = camshaft position sensor

Rotate the flywheel until a tooth on the camshaft's toothed wheel is opposite the sensor's hole in the timing cover. Fit the camshaft position sensor and measure the distance **A** using a feeler gauge between the sensor's tip and the toothed wheel. Permissible clearance **A**: 0.6 ± 0.4 mm. To obtain a correct signal from the camshaft position sensor the clearance between sensor and toothed wheel must lie within these limits. Adjust the sensor by means of shims in accordance with the table below.

A	B	
Measured clearance	Shim	
	Quantity	Part no.
0.2–1.0 mm	—	—
–0.3 till 0.3 mm	1	1677894
–0.6 till –0.3 mm	2	1677894

NOTE: Do not forget to fit the two clamps on the camshaft position sensor wiring.

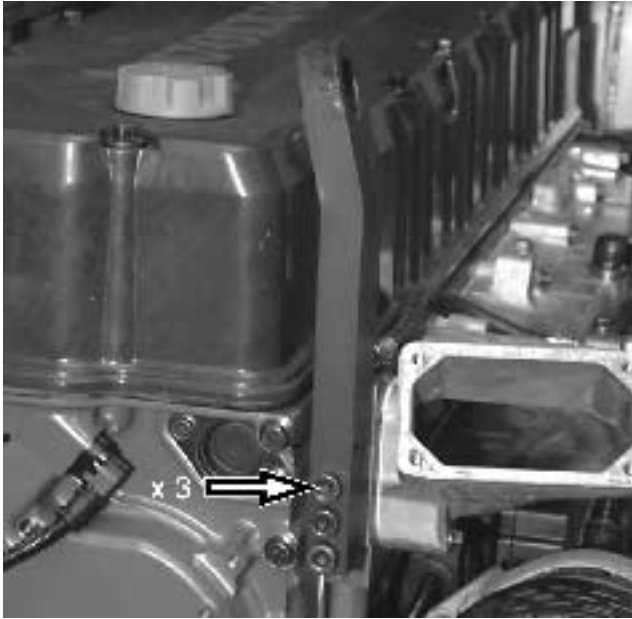
35

Clean the threaded holes for the studs in the cylinder head. Clean the studs, coat them with Volvo Penta locking fluid, part no. 161053–2, and tighten them to 40 ± 3 Nm.

Attach the wiring to the unit injectors by means of straps round the studs.

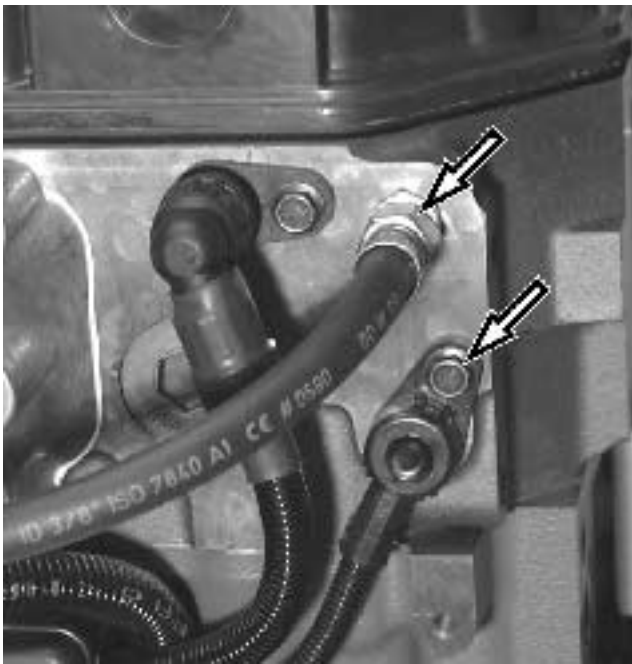
NOTE: Meticulously wipe off all surplus locking fluid after tightening the studs.

36



Fit the front engine lifting bracket.

37



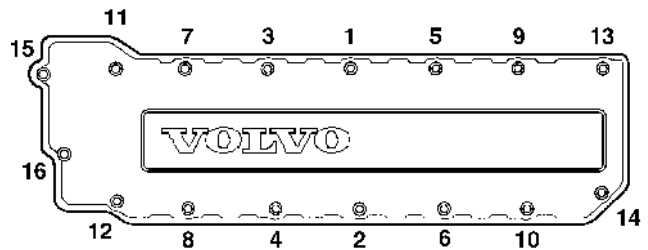
Attach the temperature sensor and fuel connections to the cylinder head with new gaskets. Tighten the fuel lines to 55 ± 5 Nm.

38

Apply a 2 mm thick bead of sealant, part no. 1161231-4, in the joint between the upper timing cover and the cylinder block.

NOTE: The valve cover must be fitted within 20 minutes of applying the sealant.

39



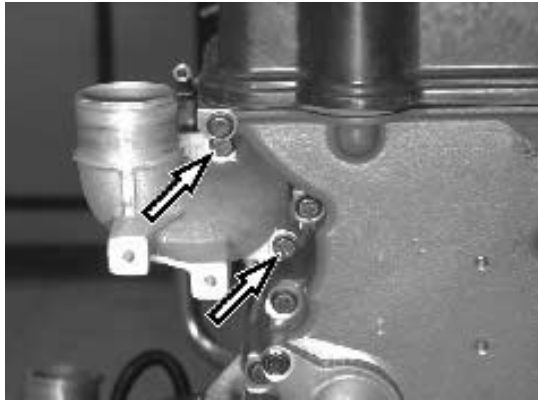
Fit the valve cover and tighten the bolts to 20 ± 2 Nm according to the tightening diagram.

NOTE: It is important that the valve cover bolts are tightened to the torque specified in the diagram to prevent cracks in the cover and loosening of the studs.

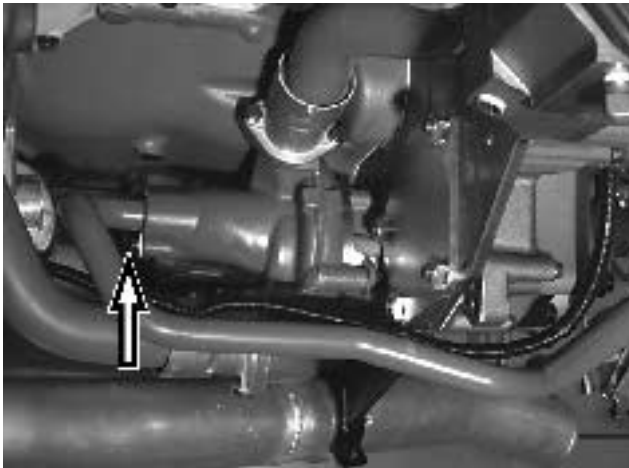
If any of the valve cover studs loosened from the cylinder head when the bolts were removed, the wiring harness to the unit injectors must be checked. The wire holder on the stud may have followed in the rotation and damaged the wiring harness.

40

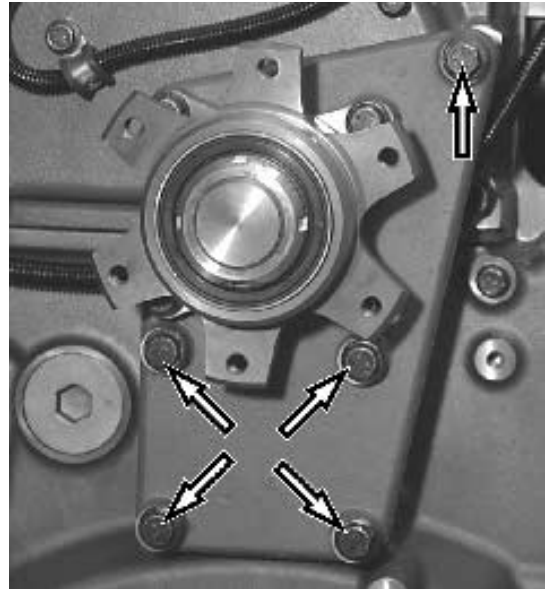
Fit the hose between the crankcase breather pipes in place and tighten the clamps.

41

Fit the upper radiator hose connection on the cylinder head with new seals.

42

Attach the water pipe to the coolant pump and radiator hose connection.

43

Fit the radiator fan drive.

NOTE: The upper bolt also secures the upper timing cover.

44

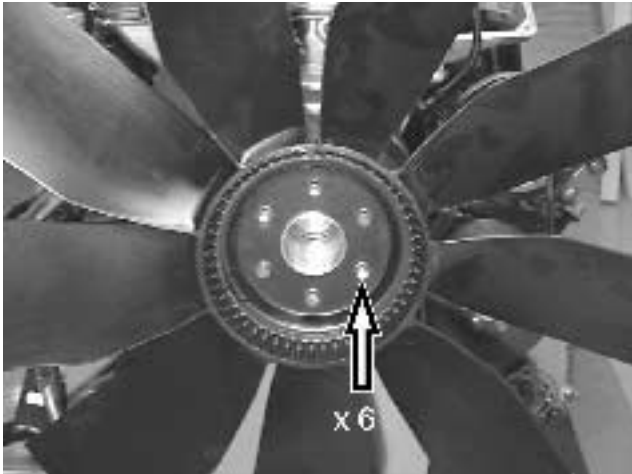
Fit the pulley and spacer.

NOTE: Center the holes for the studs with the pulley and spacer.

45

Fit the drive belt, see "Group 26, Drive belts, changing".

46



Fit the radiator fan (six studs).

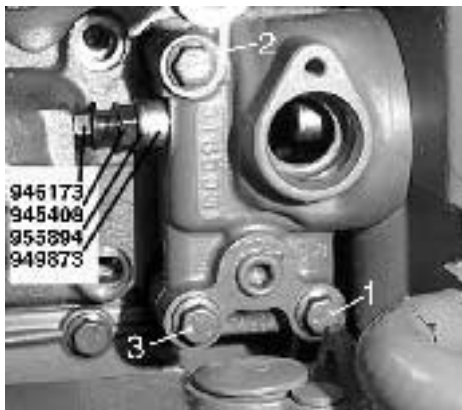
47

Fit the protective plates round the drive belts.

48

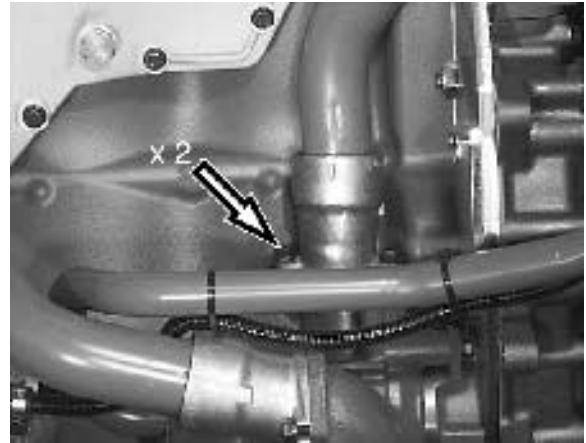
Fit the radiator assembly, see "Radiator element, changing".

49



Fit the thermostat and thermostat housing with new seals. Tighten by hand. Fit a bolt (M8 x 20) with nut, washer and spacer sleeve between the lug on the exhaust manifold and the machined surface on the thermostat housing. Tighten the bolt so that the sleeve presses the thermostat housing against the piston thermostat seal. Secure the thermostat housing according to the tightening diagram (see illustration). Remove the tensioning screw.

50



Fit the coolant pipe between the thermostat housing and coolant pump.

51

Fit the exhaust manifold and turbocharger. See "Group 25, Gasket, exhaust manifold, changing".

512(TAD)

Fit the lower charge air pipe on the turbocharger.

53

Fit the inlet manifold, see "Group 25, Inlet manifold, changing".

54

Fill up with the requisite quantities of oil and coolant.

55

Bleed the fuel system. See "Group 23, Fuel system, bleeding".

56

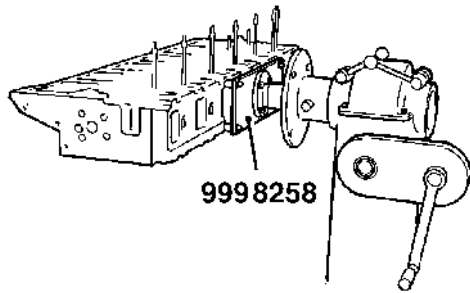
Start the engine and perform functionality and integrity checks.

Cylinder head, leakage check

Prior conditions: Cylinder head removed

Special tools: 9996662, 9998258, 9998266, 9998511, 9998619, 9998666, 9998668, 9996485 Other special equipment: 946173, 945408, 955894, 949873 (Included in 9998666 and 9998668: 980 9696, 980 9697, 980 9698, 980 9699, 980 9700, 980 9701)

1



Fit the cylinder head in an engine stand.

2

Remove the valve yoke.

NOTE: Mark the yoke so that it can be refitted at the same place.

3

Remove the exhaust manifold. See "Group 25, Gas-ket, exhaust manifold, changing".

4

Remove the thermostat housing and piston thermostat. See "Group 26, Piston thermostat, changing"

5

Remove the cylinder head from the engine stand.

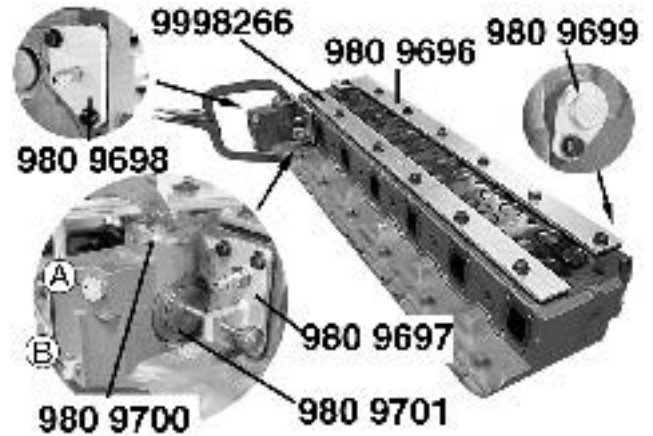
6

Thoroughly wash and clean the cylinder head.

7

Fit the cylinder head in the engine stand.

8



Clean the contact surfaces of the cylinder head.

Fit sealing washers 9998266 and 980 9696 on the cylinder head with cylinder head bolts (13 bolts and 13 M16 nuts).

Fit sealing washer 980 9697 with plug 980 9701 in place of the thermostat housing.

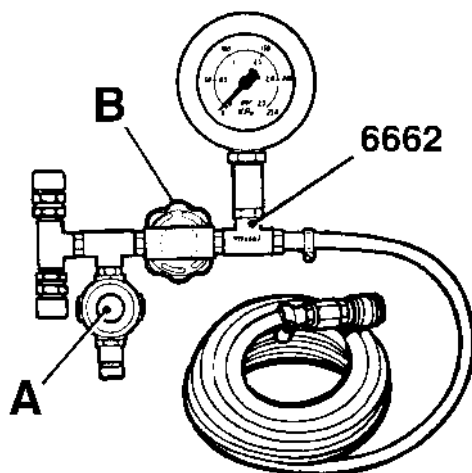
Fit sealing washer 980 9699 in the hole for the temperature sensor (at the back edge of the cylinder head).

If the area in which the thermostat sits is to be checked for leakage, fit sealing washer 980 9698 and clamp 980 9700.

Remove the pipe connections on the cylinder head and fit plugs A and B in the holes (see illustration).

Checking test equipment

9

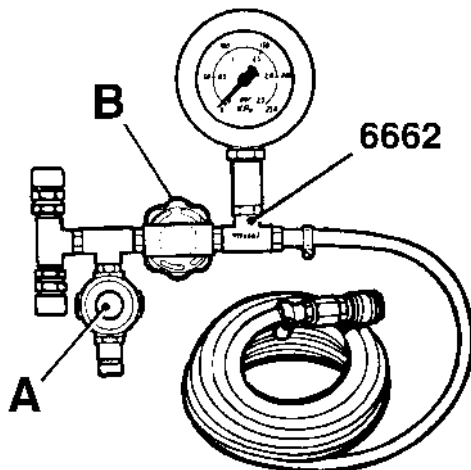


Check that the cock on the reducing valve (A) is unscrewed and attach leakage check tool 9996662 to the pneumatic system. Open the cock (A) and set the reducing valve so that a pressure of 100 kPa shows on the pressure gauge.

OBS! The knob on the reducing valve can be locked by turning the snap ring axially.

NOTE: Always follow applicable safety regulations.

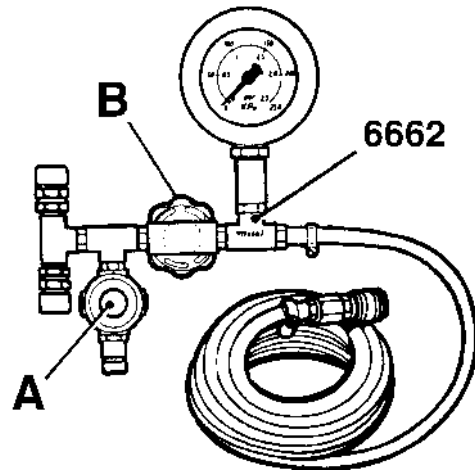
10



Close the cock (B). For the test equipment to be considered reliable, the pressure must not sink for two minutes.

Leakage check

11



Check that the knob on the reducing valve (A) is unscrewed.

12

Fit the hose from the pressure gauge onto the connection nipple (980 9697).

13

Remove the cylinder head from the engine stand.

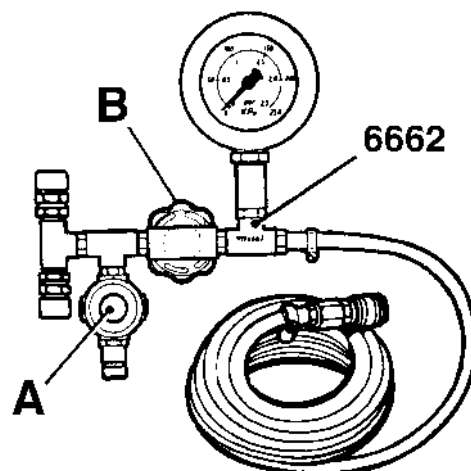
14

Lower the cylinder head into a water bath (70° C/158° F).

15

Connect the leakage check equipment to the pneumatic system.

16



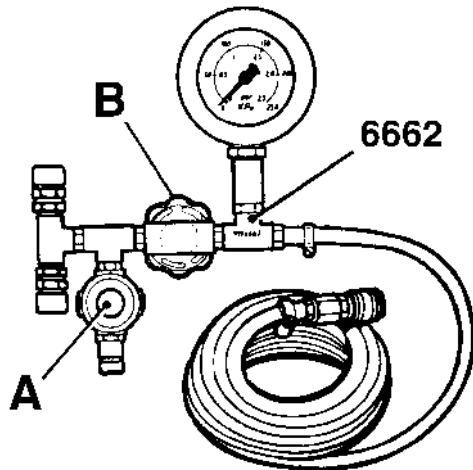
Open the pneumatic system and set the reducing valve (A) so that a pressure of 50 kPa shows on the pressure gauge. Maintain the pressure for 1 minute.

17

Raise the pressure to 150 kPa. Lock the reducing valve knob with the snap ring. Close the cock of the pneumatic system.

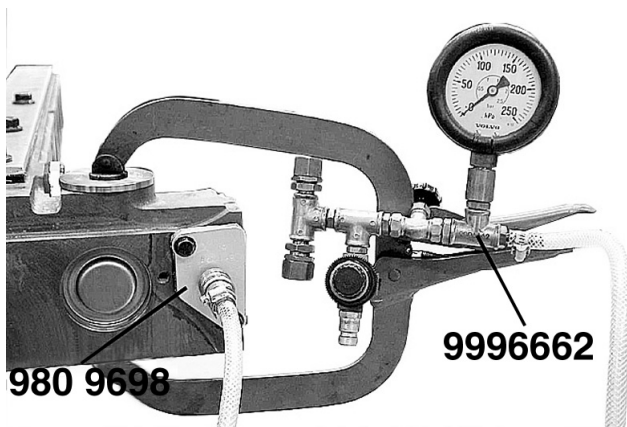
After one or two minutes, check that the air pressure does not sink and that no air bubbles come from the cylinder head.

18



Release the air pressure from the cylinder head by unscrewing the reducing valve (A).

19



Move the test equipment to the connection nipple on the thermostat housing.

Perform a leakage check following steps 16 and 17.

20

Remove the cylinder head from the water bath.

21

Fit the cylinder head in the engine stand.

22

Dry the cylinder head with compressed air. Be especially careful to ensure that the fuel passages are clean and dry.

NOTE: Dirt or foreign particles in the fuel passages could damage the unit injectors.

23

Remove all sealing washers.

24

Remove the plugs for the thermostat housing and fit the pipe connections on the cylinder head.

25

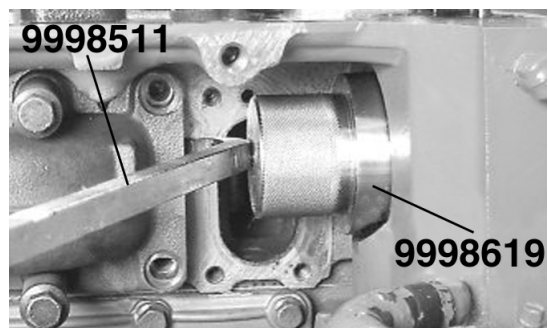
Fit the exhaust manifold, see "Group 25, Gasket, exhaust manifold, changing".

26



Remove the seal for the piston thermostat in the cylinder head. Use a suitable drift.

27



Clean all seal surfaces and fit a new seal on drift 9998619.

NOTE: Turn the sealing ring with the broad edge against the shoulder of drift 9998619.

Press drift 9998619 into the cylinder head with crowbar 9998511 until drift 9998619 bottoms against the cylinder head.

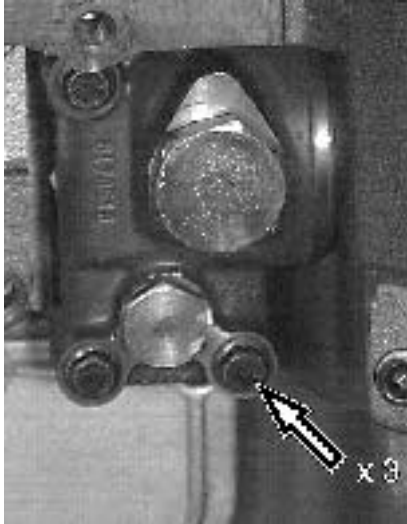
Remove the drift and check that the seal sits correctly.

28

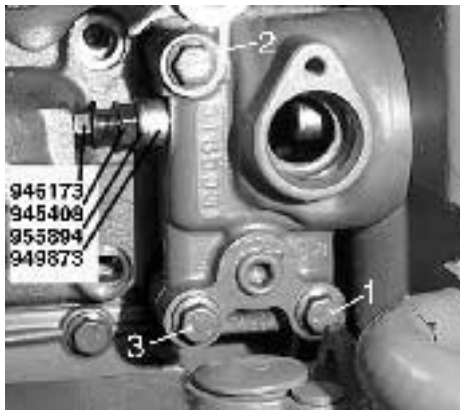
Check the seal on the piston thermostat. Replace as necessary. See "Group 26, Piston thermostat, changing".

29

Fit the new piston thermostat in the cylinder housing.

30

Fit the thermostat housing with new seals. Tighten the bolts by hand.

31

Fit a bolt (M8 x 20) with nut, washer and spacer sleeve between the lug on the exhaust manifold and the machined surface on the thermostat housing. Tighten the bolt so that the sleeve presses the thermostat housing against the piston thermostat seal. Secure the thermostat housing according to the tightening diagram (see illustration). Remove the tensioning screw.

32

Fit the last two bolts on the exhaust manifold.

33

Oil the handles of the valve yokes and fit them.

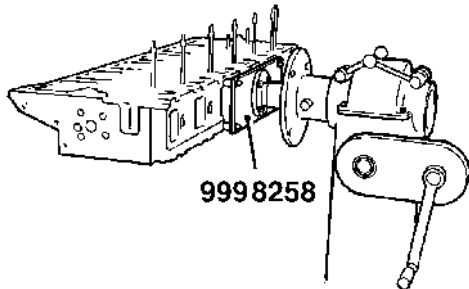
34

Fit the cylinder head, see "Cylinder head, fitting".

Cylinder head, valves removing/fitting

There are two methods of removing/fitting valves.

Fastening the cylinder head in an engine stand



Work on the cylinder head will be facilitated if it is fastened in an engine stand. In order to fasten tool 9998258 to the cylinder head it will first be necessary to remove the inlet manifold. Also remove the exhaust manifold if the cylinder head is to be removed. Bolt tool 9998258 to the cylinder head using 4 M8x50 bolts.

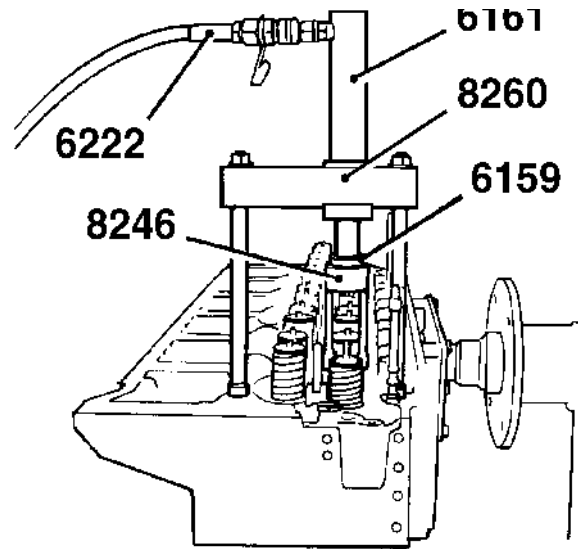
NOTE: It is extremely important to observe the strictest cleanliness when working on the cylinder head.

Dirt particles in the fuel passages could cause a breakdown or malfunction of the unit injectors.

Removing valves

Special tools: 9996159, 9996161, 9996222, 9998246, 9998258, 9998260, 9998335, 9998506

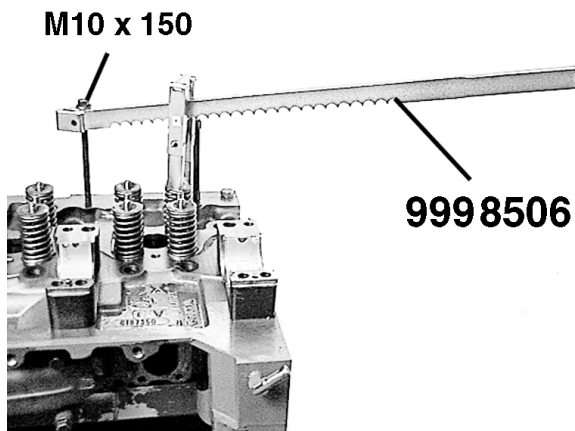
1



- Fit press tool 9998260 together with the valves' counterstay.
- Fit hydraulic cylinder 9996161 in press tool 9998260 and connect foot pump 9996222.
- Insert pin 9996159 in the hydraulic cylinder. Depress the valve disc using tool 9998246. Remove the valve collets.
- Remove the valve disc, the springs, the valve yoke guide pins and the valves.
- Place the valves and springs in a marked stand so that they can be refitted in the same cylinder head places.
- Remove the remaining valves the same way using the press tool.
- Remove the oil seals from the valve guides.

Alternative removal

2



Alternatively, tool 9998506 can be used instead of the hydraulic cylinder.

NOTE: Place the cylinder head on a clean, level surface.

NOTE: Make sure that the cylinder head is not scratched when the valves are removed.

Valves, fitting

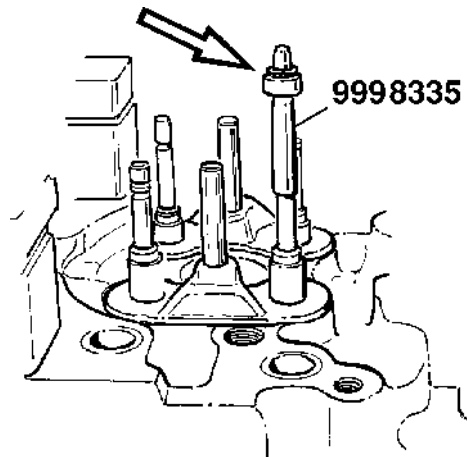
3

Oil the valve stems and fit the valves.

4

Fit the valve yoke guide pins.

5



- Fit tool 9998335 and press the new oil seals down over the valve guides.

NOTE: Make sure that the oil seals are firmly pressed down into place.

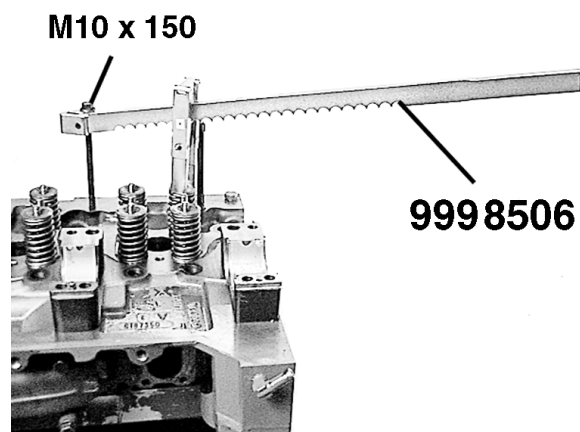
- Fit the spring or springs.

NOTE: The exhaust valves have double springs.

- Fit the valve disc using the same tool as for dismantling. Carefully depress the spring (springs) and fit the valve collets.

Alternative fitting

6



Alternatively, tool 9998506 can be used instead of the hydraulic cylinder.

NOTE: Place the cylinder head on a clean, level surface.

NOTE: Make sure that the cylinder head is not scratched when the valves are fitted.

Valve guides, inspecting

4

Cylinder head removed

Other special equipment: 9989876, 9999696

1

Remove the oil seal from the valve guide.

2

Place the cylinder head horizontally in the stand.

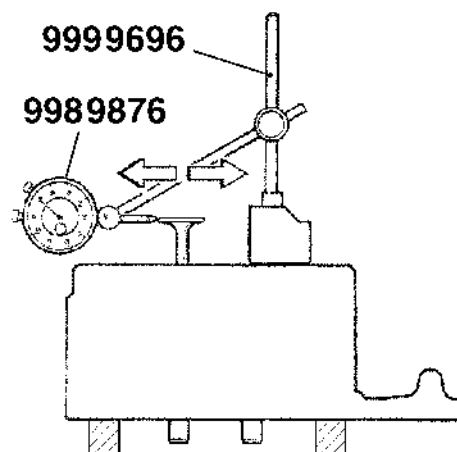
Turn the cylinder head so that the valve heads face upwards.



IMPORTANT! Do not lay the cylinder head in such a way that it rests on the valve guides (see illustration, point 4).

3

Place a new valve in the valve guide so that the end of the valve stem is level with the edge of the guide. Use a suitable counterstay for the valve stem.



Place dial indicator 9989876 with magnetic stand 9999696 so that the tip of the dial indicator lies against the edge of the valve head.

Move the valve laterally in the direction of the inlet and exhaust port. Note the reading on the dial indicator.

5

Check all valve guides. If the reading values exceed those given in the specifications, the valve guide must be replaced.

Clearance valve handle - guide:	
Inlet	0.03–0.05 mm
Wear tolerance	0.2 mm ¹
Exhaust	0.04–0.07 mm
Wear tolerance	0.3 mm ¹

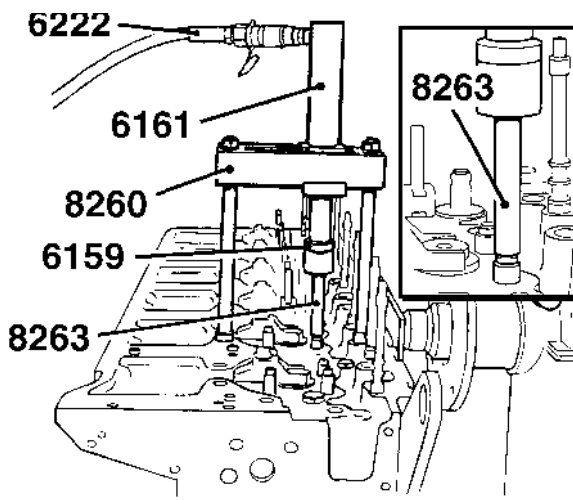
¹ Max. permissible clearance between valve handle and valve guide.

Valve guides, changing

Special tools: 9996159, 9996161, 9996222, 9998260, 9998261, 9998262, 9998263

Removing

1



Fit press tool 9998260 in the holes for the cylinder head retaining bolts.

NOTE: Place washers between the nuts and the cylinder head surface.

Tighten the nuts on the tool.

2

Fit pin 9996159 in the hydraulic cylinder.

3

Fit hydraulic cylinder 9996161 in tool 9998260 and press out the valve guide using drift 9998263 and foot pump 9996222.

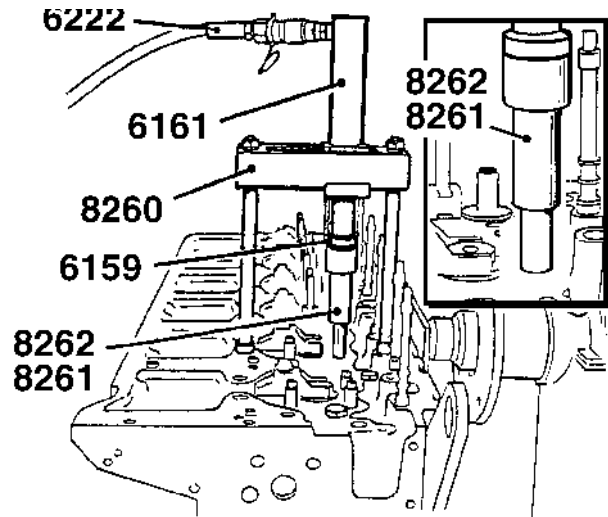
Press out the other valve guides in the same manner.

Fitting

4

Oil the outside of the valve guides with engine oil before fitting them in place.

5



Press in the valve guide for the inlet valve using tool 9998261. Press in the exhaust valve guide using tool 9998262.

NOTE! Tool 9998261 is marked *Inl.* Tool 9998262 is marked *Ex.*

Keep pressing until the tool bottoms against the surface of the cylinder head.



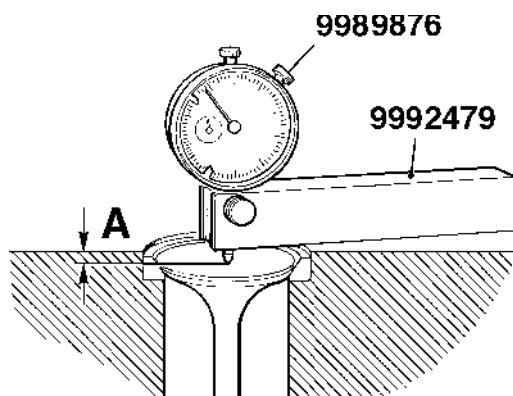
IMPORTANT! After changing the valve guides, the cylinder head should be cleaned to prevent particles from entering the fuel chamber or oil passages. Dirt particles in the fuel passages could cause a breakdown or malfunction of the unit injectors.

Valve seat, changing

Special tool: 9992479

Other special equipment: 9989876

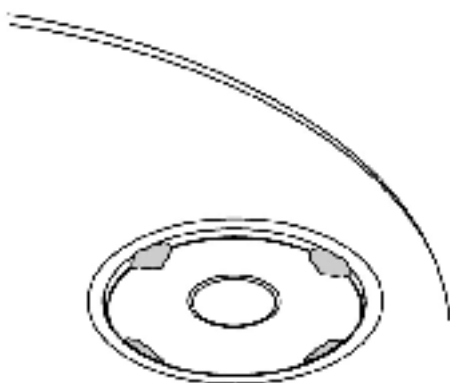
1



The valve seats should be changed when the distance "A" measured with a new valve exceeds the value specified below.

Height (measurement A):	
Inlet	8.4–8.6 mm
Exhaust	7.9–8.1 mm

2



Grind down the head of an old valve so that it comes about 1–3 mm further down in the seat.

Weld the old valve to the valve seat with four spot welds (MAG welding).

⚠ IMPORTANT! Carefully cover other parts of the cylinder head so that welding spatter cannot adhere to it.

3

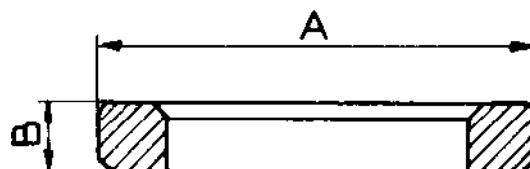
Tap out the valve seat.

NOTE! Be careful not to damage the cylinder head.

4

Clean the valve seat meticulously and examine the cylinder head for cracks.

5



Measure the diameter of the valve seat position. Ascertain whether a seat of standard size or oversize is to be used. Machine the seat position if necessary.

Outer size (measurement A) Standard:	
Inlet	43.1 mm
Exhaust	43.1 mm
Oversize:	
Inlet	43.3 mm
Exhaust	43.3 mm
Height (measurement B):	
Inlet	8.4–8.6 mm
Exhaust	7.9–8.1 mm
Inlet (D12D)	7.15–7.35 mm

6

Chill the seat in dry ice to between -60°C and -70°C (-76°F and -94°F) and heat the cylinder head with hot water from a hose or in some other way. Press the valve seat into place using a drift.

NOTE: Turn the seat so that the seat angle faces the tool.

7

Machine the seat to the correct angle and width.

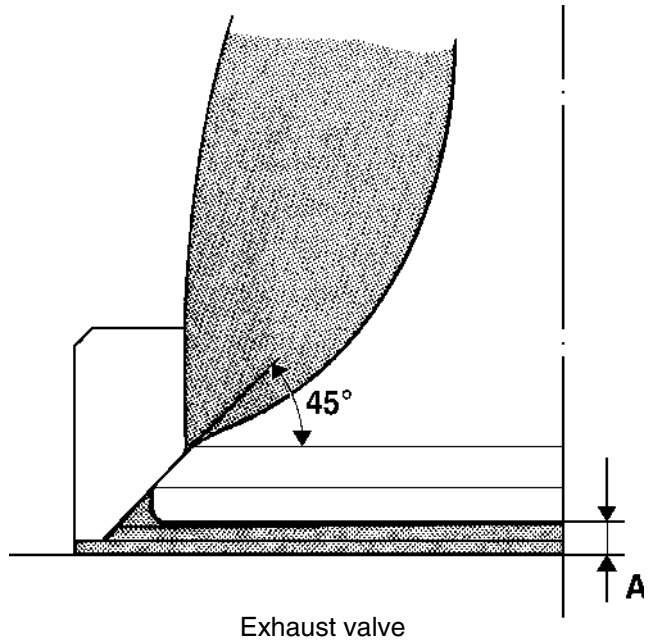
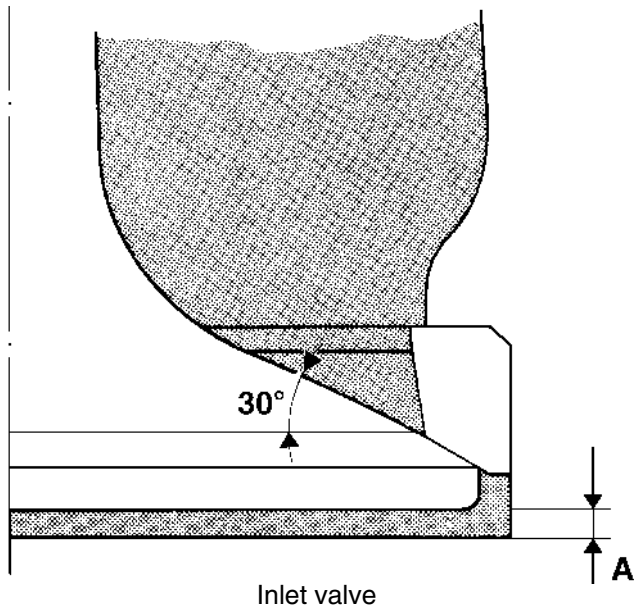
Valve seat, grinding

1

Before grinding the valve seats, check the valve guides and replace them if wear tolerances are exceeded.

2

When grinding the valves seats, do not take away too much material unnecessarily. Take away just enough to give the valve seat the correct form and the valve head a good contact surface.



The new valve seat is grinded down so that the measurement (**A**) between the cylinder head surface and the valve head surface, measured with a new valve, meets specifications. See "Valve seat, changing".

4

The valve seat angle is checked with a valve seat gauge after a thin layer of marking paint is applied to the seat's contact surface.

Valves, grinding

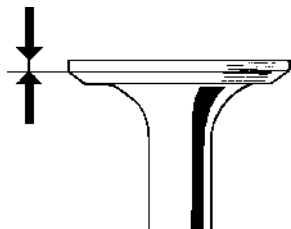
Valves' sealing angles

Inlet 29.5°

Exhaust 44.5°

1

Grind the seal face as little as possible, but enough to grind away all damage.



2

Check the measurement (**A**) of the valve head's edge. If the measurement is less than the wear tolerance below, the valve must be replaced.

Inlet (new valve) Min	1.8 mm
Wear limit	1.4 mm
Exhaust (new valve) Min	1.6 mm
Wear limit	1.2 mm

Always replace valves with crooked valve stems.

3

Check the integrity of the valves with marking paint.

If there is leakage, grind the valve seat again, but not the valve. Then perform another check.

Rocker arm mechanism, changing

The following components are replaceable: rocker arm bridge, expansion plugs, complete rocker arms and adjusting screws.

1

Remove the rocker arms from the rocker arm bridge. Mark the rocker arms so that they can be refitted in the right order.

2

Clean the parts. Pay particular attention to the oil passage in the bearing housing and the oil holes in the rocker arm bridge and rocker arms.

3

Check the rocker arm bridge and ball studs for wear. The threads on ball studs and lock nuts should be undamaged. If the bush of any rocker arm is worn oval, the entire rocker arm should be changed.

4

Oil the rocker arm bridge and refit the rocker arms in the right order.



IMPORTANT! It is extremely important that the rocker arms and rocker arm bridge are thoroughly cleaned and lubricated with engine oil before the rocker arms and shafts are assembled.

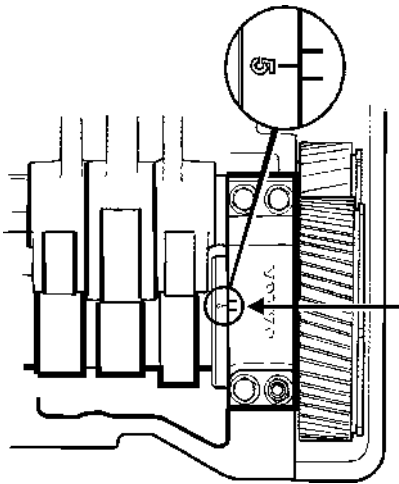
Valves and unit injectors, adjusting

Special tools: 9993590, 9998583, 9999696

Other special equipment: 9989876

Setting marks

1



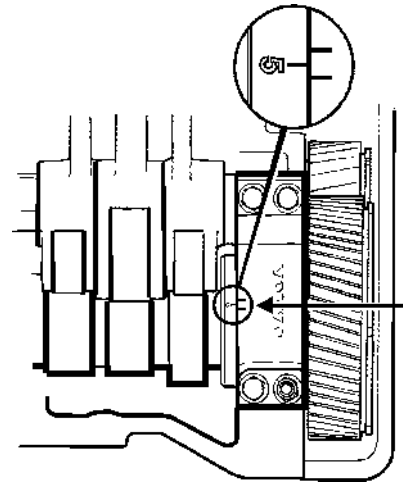
Setting marks for valves and unit injectors

The engine is marked with numbers (1–6) for valves and unit injectors (cylinder no. 6 is nearest the fly-wheel). Each number applies to the adjustment of inlet valves, exhaust valves and unit injectors for the respective cylinders.

NOTE: When adjusting, it is important to ensure that the line marked on the camshaft is midway between the marks on the bearing cap.

Setting mark, bearing cap

2



Adjusting, general

3

The instructions cover adjustment of valves and unit injectors in the following order:

Exhaust valves
Inlet valves
Unit injectors

NOTE: Exhaust valves, inlet valves and unit injectors are to be adjusted at the same time for each cylinder.

Valves and unit injectors should be adjusted in the order as marked on the camshaft when the engine is turned over in the direction of rotation.

By following this order, the crankshaft need not be rotated more than two revolutions for the adjustment of all valves and unit injectors.

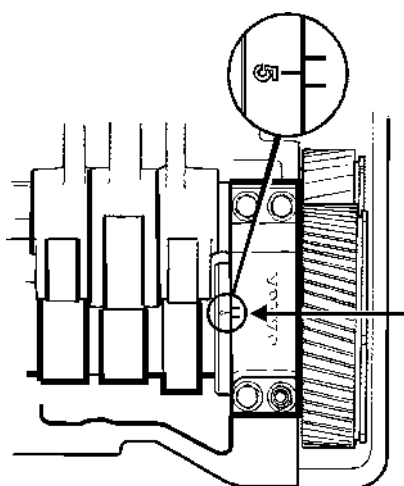
A colored pencil can be used to mark the rocker arms that have been checked or adjusted.

4



Mount turning tool 9993590.

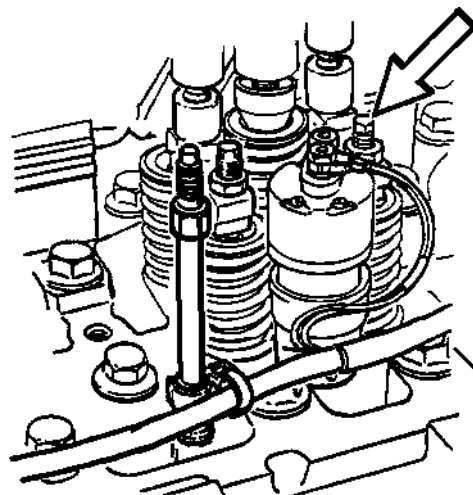
5



Check that the line marked on the camshaft is mid-way between the marks on the bearing cap. The numbers indicate the cylinder for which the valves can be adjusted.

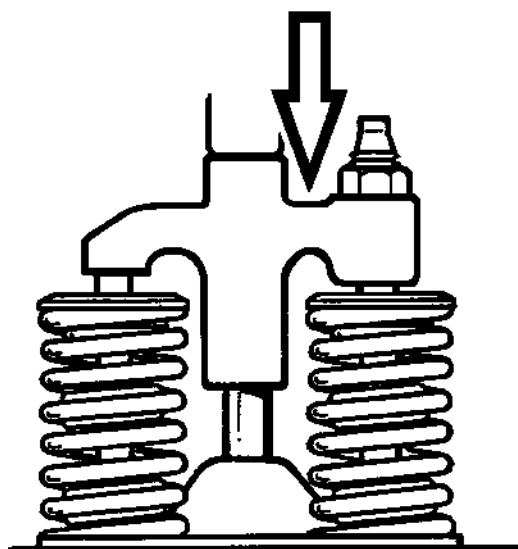
Valve yoke, adjusting exhaust valves

6



Adjust the valve yoke by slackening the adjusting screw until it is clear of the valve stem.

7



Screw in the adjusting screw until it reaches the valve stem and then an additional hexagon side (60°).

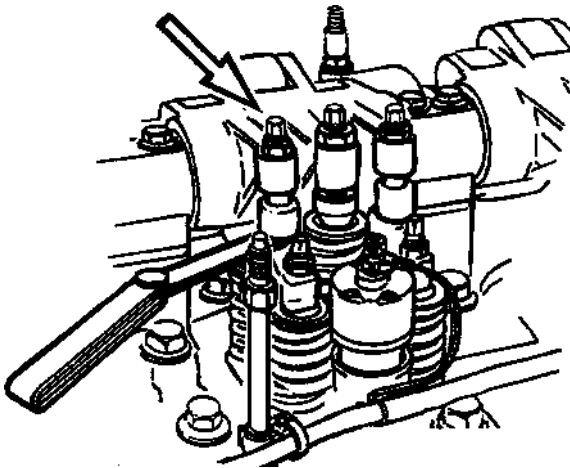
Tighten the lock nut to 38 ± 4 Nm.



IMPORTANT! When screwing down the adjusting screw the valve yoke must be pressed down at the same time so that it reaches the valve stems. It is **extremely important** that pressure is applied as close as possible to the adjusting screw, see arrow in illustration. Incorrect adjustment of the valve yoke could lead to a breakdown.

Setting valve clearances

8



Adjust the valve clearances correctly and tighten the lock nut to 38 ± 4 Nm.

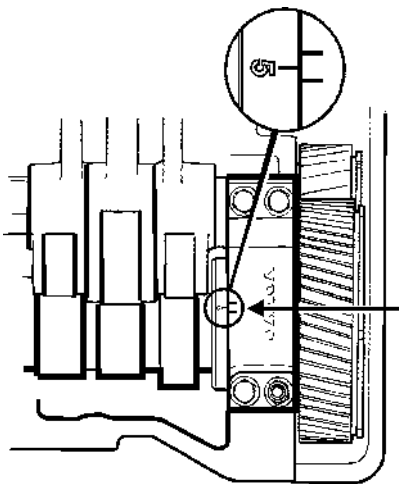
Check the valve clearance.

9

Adjust the inlet valves the same way as the exhaust valves but with a different clearance.

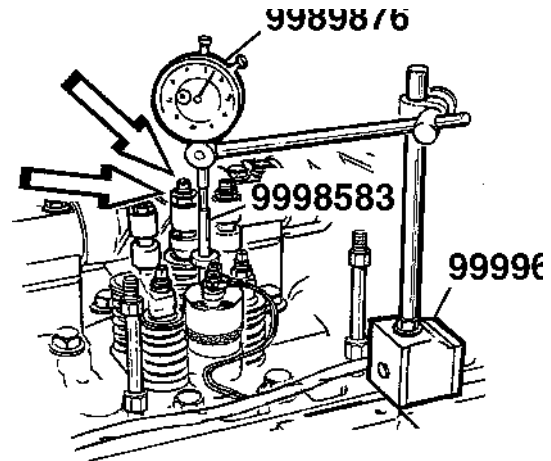
Unit injectors, adjusting prestress

10



Check that the line marked on the camshaft for adjusting the inlet valves and unit injectors is midway between the marks on the bearing cap. The numbers indicate which unit injector can be adjusted.

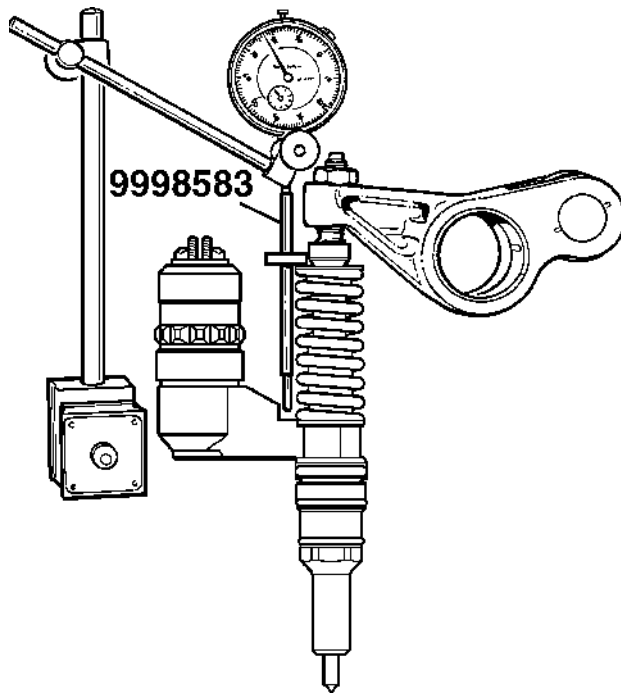
11



Mount gauge 9998583 on dial indicator 9989876 with magnetic stand 9999696.

Position the dial indicator so that the flange of the gauge rests against the unit injector's spring disc and the tip points towards the plane between the spring seat and the fuel valve.

12



Prestress the dial indicator 2–3 mm.

Prestress the unit injector by screwing down the adjusting screw until the gauge bottoms against the plane surface and the dial indicator's pointer stops.

Tighten the lock nut to 52 ± 4 Nm.

NOTE: If adjustment is incorrect the unit injector could bottom, resulting in damage to the camshaft and unit injectors.

Functionality check

13

Perform a functionality check by starting the engine and running it until normal operating temperature is attained.

Then run the engine another 4–10 minutes at idling speed. Once idling speed is steady the cylinder balancing system will have set the correct amount of fuel for the unit injectors.

13

NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the cover.

Cylinder liners and pistons, removing

Special tools: 9992955, 9993590, 9996394, 9996395, 9996645, 9996966

1



Fit press tool 9996966 on the cylinder liners that are not to be removed.

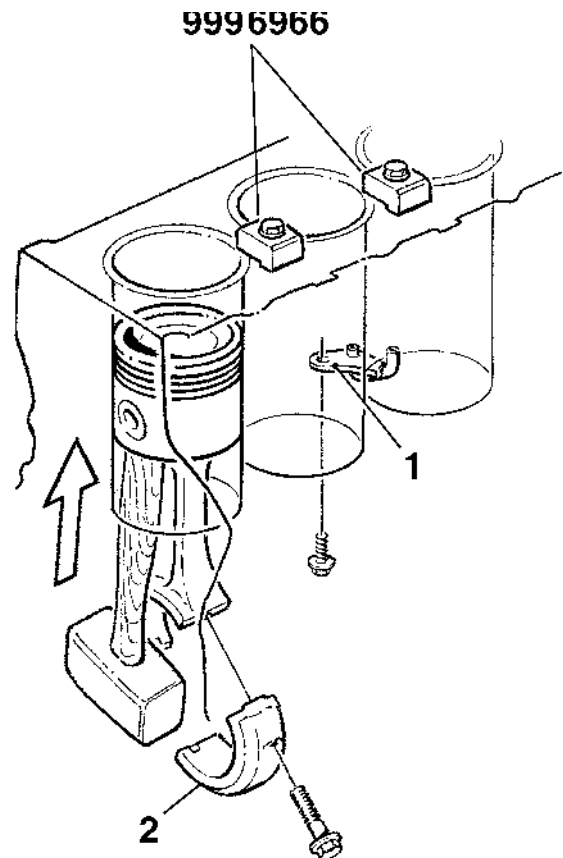
2



Mount turning tool 9993590 and rotate the flywheel until the connecting rod that is to be removed comes into position.

NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the cover.

3



Remove the piston cooling nozzle (1).

Remove the connecting rod big-end cap and bearing shells (2).

Press the piston up until the piston rings come above the edge of the cylinder liner.

(Use the handle of a hammer or other wooden object.)

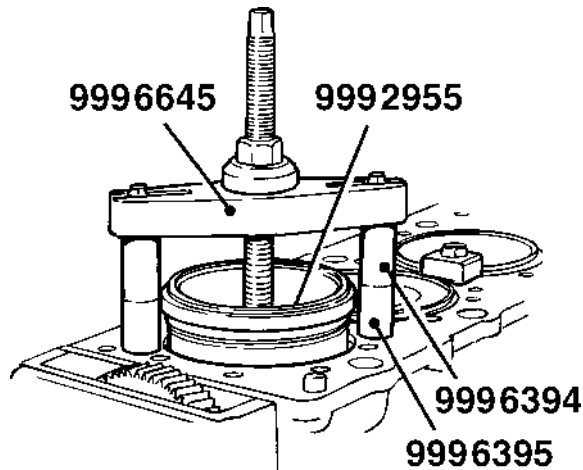
Lift out the piston and connecting rod.

⚠ WARNING! Incorrect piston cooling leads to piston shearing.

If you believe the piston cooling nozzle could be damaged or deformed, it must be replaced. This also applies to new nozzles. Always check that the piston cooling nozzle sits correctly in the hole on the cylinder block and that the anchor plate lies flat against the cylinder block.

If the piston cooling nozzle is not correctly fitted, there is a risk that the engine will break down immediately upon start.

4



Mark the position of the cylinder liner in the block. Mount the tools on the cylinder head, see illustration. Withdraw the cylinder liner.

5

Remove all sealing rings (3) from the cylinder block.

Cylinder liners and pistons, inspecting

Cylinder liners and pistons must be thoroughly cleaned before inspection and measurement.

Cylinder liner wear can be measured with the liner mounted in the cylinder block.

NOTE: To thoroughly check for cracks, the cylinder liner must be removed from the cylinder block.

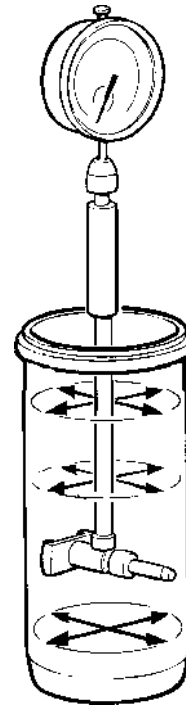
Mark the position of the cylinder liner with a felt-tip pen before removing it so that it can be refitting in the correct position.

Cylinder liners

1

Check for cracks, being especially thorough when checking the liner flange. The magnaflux method can be used when checking for cracks.

2



Measure the wear of the cylinder liner with a cylinder indicator. To get as precise a wear measurement as possible, the cylinder indicator should first be set with a gauge ring or micrometer. Use the original diameter of the cylinder liner as the base value.

3

Measure the cylinder liner from both the top and bottom and several places vertically.

At each measurement spot, the measurement must be taken both along the engine and across it.

4

If wear is greater than 0.45–0.50 mm a new complete liner kit must be used (piston, liner, piston rings, piston pin and seals).

Oil consumption is also of importance for when cylinder liners should be replaced.

NOTE: Cylinder liners and pistons are classed together. This means that pistons and liners must not be mixed together.

Pistons and cylinder liners are delivered as spare parts only in complete units.

Pistons

1

Pistons must be replaced if there are deep scratches in the casing surface, piston ring stops are damaged or cracked, piston ring grooves are worn or snap ring grooves are damaged.

Cylinder liner seat, reconditioning

A damaged cylinder liner seat is repaired by milling the liner shoulder. Compensation is made for the material removed through milling by using shims, which are found in varying thickness.

Special tools: 9992479, 9996966, 9998272

Other special equipment: 9989876

1

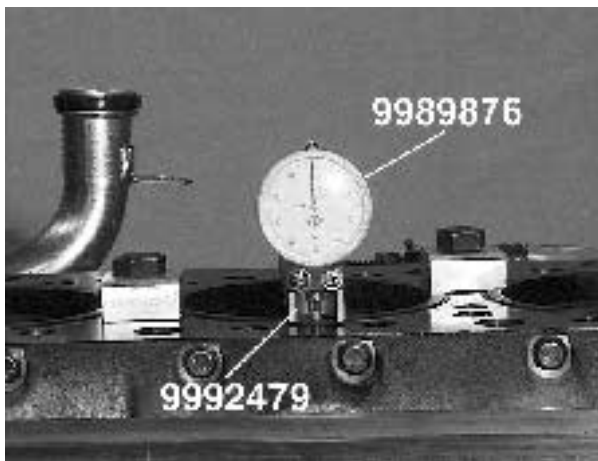
Clean the liner seat and determine the extent of the damage.

2



Mount the cylinder liner without sealing rings and secure the liner with press tool 9996966.

3



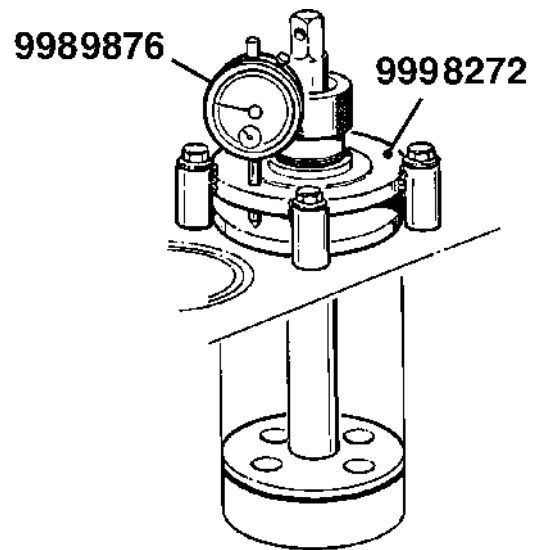
Mount tools as shown in the illustration. Measure the height of the cylinder liner at four different points and calculate the thickness of the shims. Endeavor to use as few shims as possible.

NOTE: Ensure that the measurements are always taken at the highest point of the seal face.
The height of the seal face must be 0.15–0.20 mm.

4

Remove the cylinder liner and roughen the cylinder liner surface with an emery cloth.

5



Secure milling tool 9998272 on the cylinder block and make sure that the feed sleeve does not press on the miller.

6

Once the milling tool is secured, tighten the feed bolt until it presses lightly against the miller and reset dial indicator 9989876.

7

Rotate the miller with even movements while rotating the feed sleeve.

NOTE: Use a ratchet wrench and sleeve to rotate the miller.

8

When the correct height has been reached, discontinue the feed and rotate the miller a few revolutions.

9

Remove the milling tool and clean the liner seat thoroughly.

Cylinder liners, fitting

Special tools: 9992479, 9996966

Other special equipment: 9989876

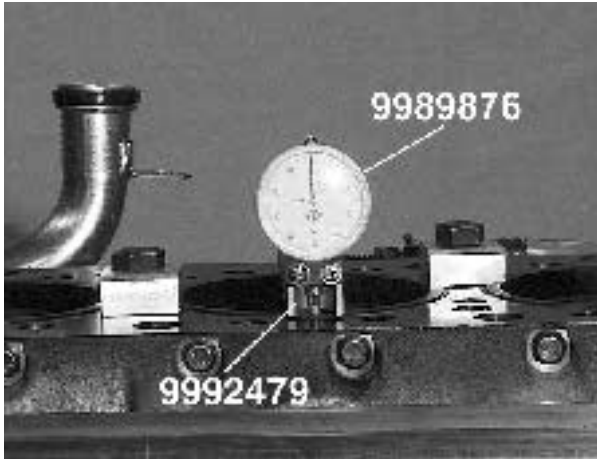
1

Make sure that the old sealing rings in the cylinder block have been removed and that the seal faces are thoroughly cleaned. Use a brass wire brush and cleaning fluid, part no. 11614401. Scraping tools must **not** be used.

2

Fit the cylinder liner without sealing rings and secure it by means of two clamps 9996966.

3

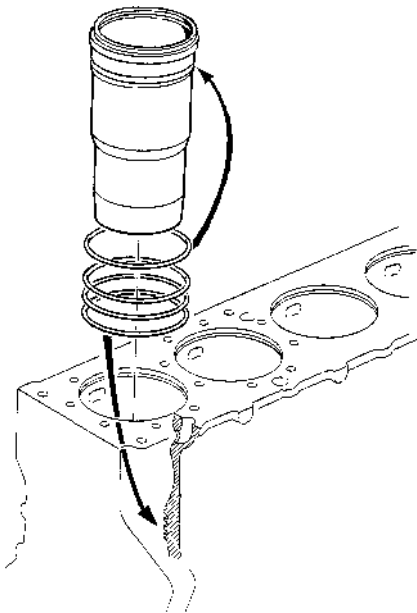


Mount tools 9992479 and 9989876 as shown in the illustration. Measure the height of the cylinder liner at four different points and calculate the thickness of the shims. Endeavor to use as few shims as possible.

NOTE: Ensure that the measurements are always taken at the highest point of the seal face.

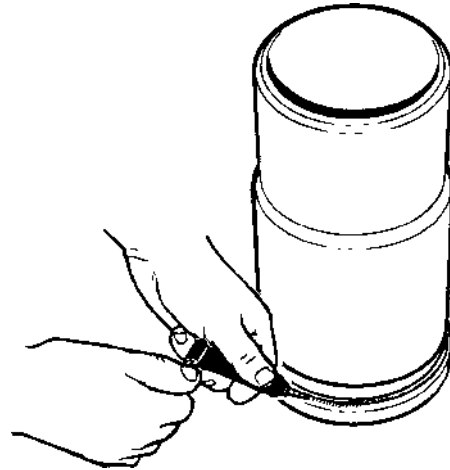
Regarding the height of the seal face, see "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE". Mark the position of the liner relative to the cylinder block so that it will be correctly positioned on assembly.

4



Remove the cylinder liner and make sure that it and any shims are kept together.

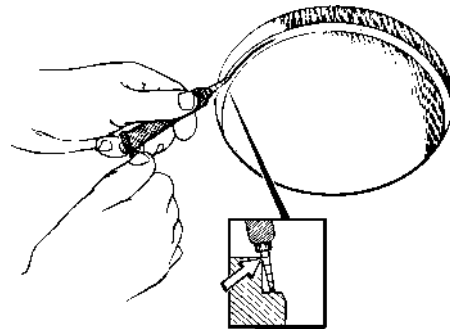
5



Lubricate the sealing rings with the lubricant supplied in the ring packaging.

NOTE: The violet ring should be fitted in the lowest groove in the cylinder block.

6



If shims are used, the bead of sealant should be applied to the liner shoulder in the cylinder block.

NOTE: Apply no sealant between the shim and liner flange. Apply a thin, even bead of sealant, part no. 11612314.

NOTE: The bead of sealant should be max. 0.8 mm.

7

The cylinder liner must be fitted within 20 minutes of applying the sealant.

8



Carefully press the cylinder liner down into the cylinder block. Fit press tool 9996966 to secure the cylinder liner in the block.

NOTE: Always fit press tool 9996966 on the cylinder liners to ensure that the sealant hardens in the right position.

Connecting rod small-end bush, checking measurements

Before the connecting rod small-end bush is changed, the connecting rod should be checked for cracks, straightness and warping.

A cracked, bent or warped connecting rod must be scrapped.

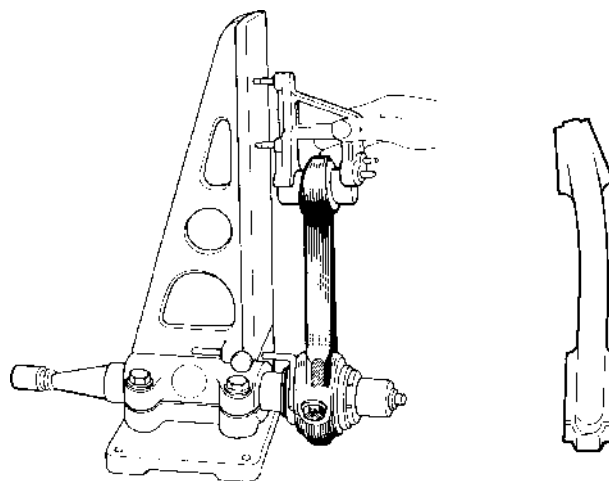
When changing connecting rod small-end bushes on connecting rods with trapezoidal piston pin ends, the bush must be machined.

The bush should be reamed. In a correct fit, an oiled piston pin should slowly slide through the bush by its own weight.



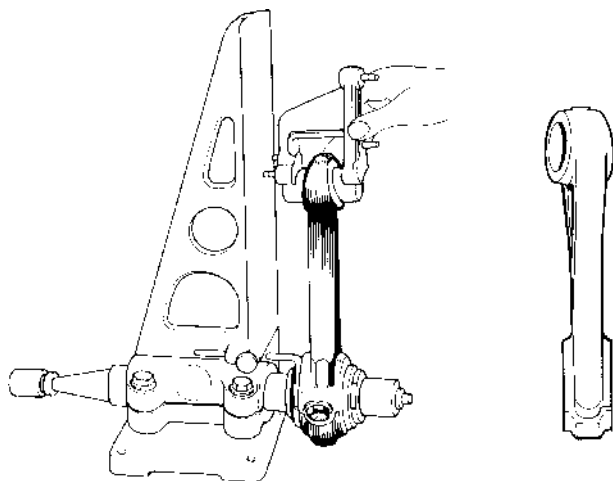
IMPORTANT! Concerning the maximum permissible deviation in respect of straightness and warping, see "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

1



Use a new piston pin and measure the straightness of the connecting rod in a jig.

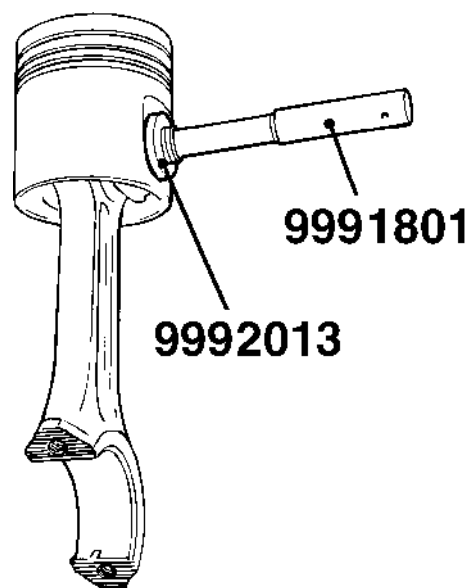
2



Measure the degree of warping of the connecting rod.

Piston, changing

Special tools: 9991801, 9992013

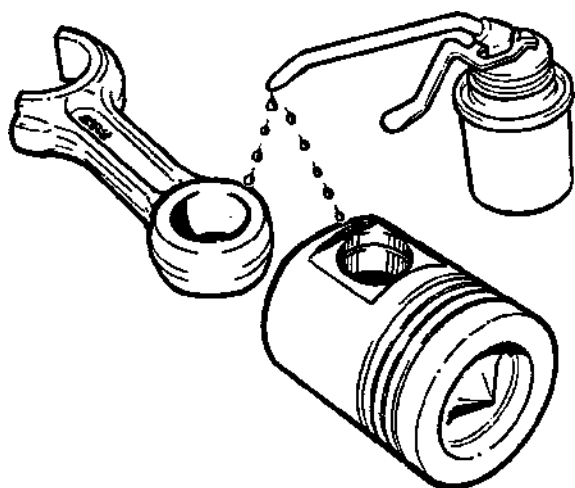
**1**

Remove the snap rings from the old piston and tap out the piston pin using tools 9991801 and 9992013. Remove the connecting rod.

2

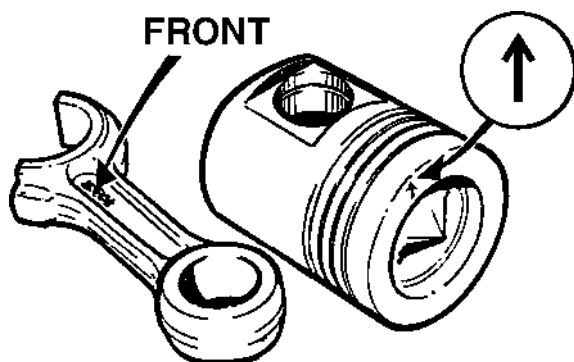
Remove one of the snap rings from the new piston.

3



Oil the piston pin, the piston bosses and the connecting rod small-end bearing with engine oil.

4



Fit the connecting rod so that the piston's arrow and the connecting rod's "Front" marking face the same direction. Press the piston pin in place using drift 9992013 and handle 9991801.

NOTE: It should be easy to press the piston pin in place. It must not be driven in by force.

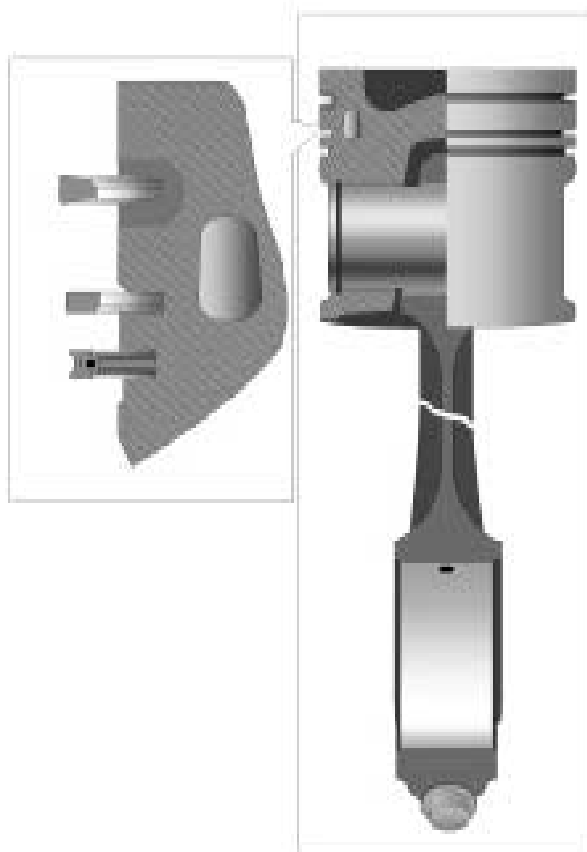
5

Fit the other snap ring.

6

Check that the top and bottom of the piston can move easily in relation to each other and that the piston pin is not a tight fit in the connecting rod small-end bush.

7



Always use piston ring pliers when fitting/removing the piston rings.

NOTE: The two upper piston rings are marked with letters or dots. The marking should face upwards.

NOTE: New cylinder liners are delivered complete with pistons and piston rings.



WARNING! Incorrect piston cooling leads to piston shearing.

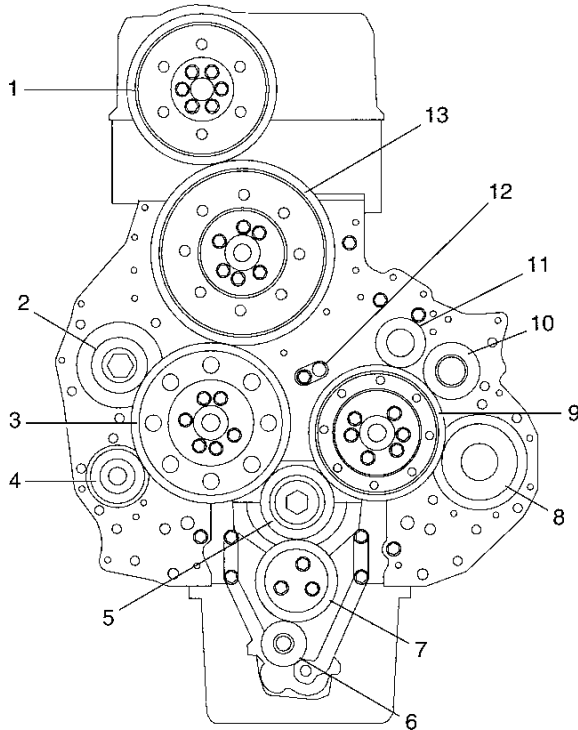
If you believe the piston cooling nozzle could be damaged or deformed, it must be replaced. This also applies to new nozzles. Always check that the piston cooling nozzle sits correctly in the hole on the cylinder block and that the anchor plate lies flat against the cylinder block.

If the piston cooling nozzle is not correctly fitted, there is a risk that the engine will break down immediately upon start.

Timing gears, changing

Prior conditions:

Oil sump removed, front engine mountings removed, valve cover removed, upper timing cover removed and coolant pump removed



1. Gear, camshaft
2. Gear, compressor
3. Intermediate gear
4. Gear, coolant pump
5. Gear, crankshaft
6. Gear, lubricating oil pump
7. Intermediate gear
8. Gear, hydraulic pump
9. Intermediate gear
10. Gear for drive belt and fuel pump
11. Gear, servo pump
12. Nozzle, gear lubrication
13. Intermediate gear, adjustable

⚠ IMPORTANT! Never rotate the crankshaft or camshaft when the timing gear has been removed. Pistons and valves could then strike each other and sustain damage.

Special tools: 884994, 9992584, 9992671, 9993590, 9996222, 9996315, 9996626, 9996965, 9998511, 9999683, 9999696

Removing gears and wheels

1

Remove the outer vibration damper.

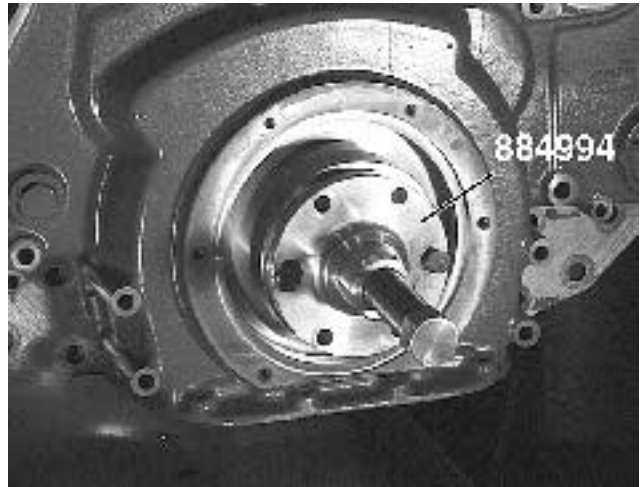
2

Remove the dust excluders and holder for the crankshaft sealing ring.

3

Remove the drive take-off, the generator and the fuel pump.

4



Remove the seal and the two socket cap screws from the driver. Use tool 884994 with two M12x60 bolts.

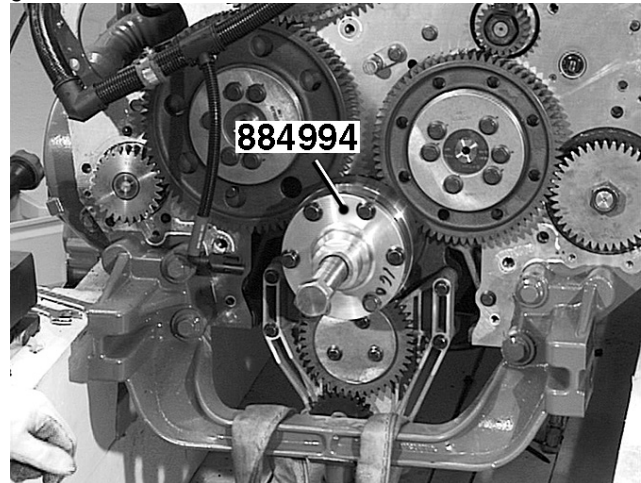
5

Remove the lower timing cover.



WARNING! The timing cover is heavy and calls for two persons to handle it.

6



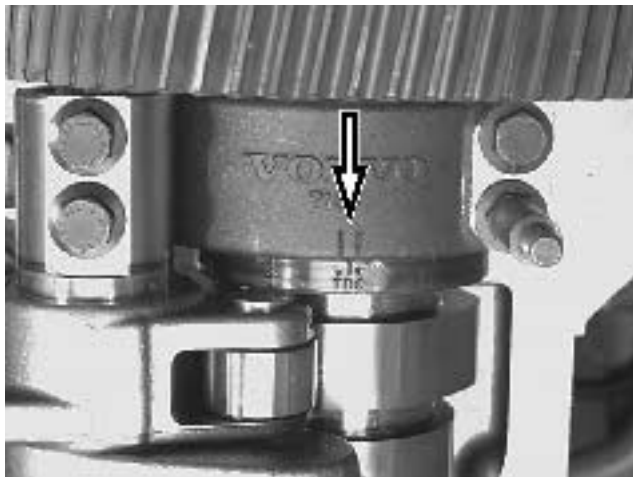
Remove the inner vibration damper. Use tool 884994 with two M12x60 bolts.

7



Mount turning tool 9993590.

8

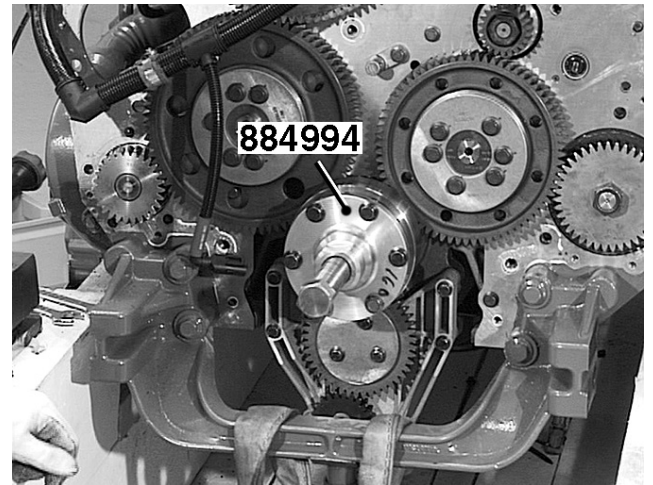


Rotate the flywheel until the piston in cylinder No. 1 is at top dead center 0° on the flywheel and the camshaft marking (TDC) is between the marks on the bearing cap.

9

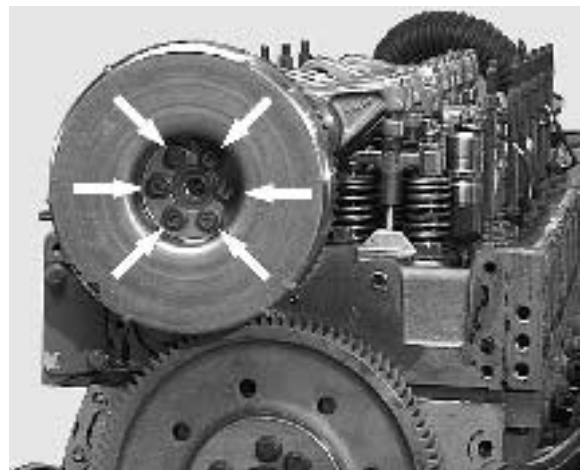
Use turning tool 9993590 with a ratchet wrench to stop flywheel rotation. Secure the ratchet wrench to the engine block.

10



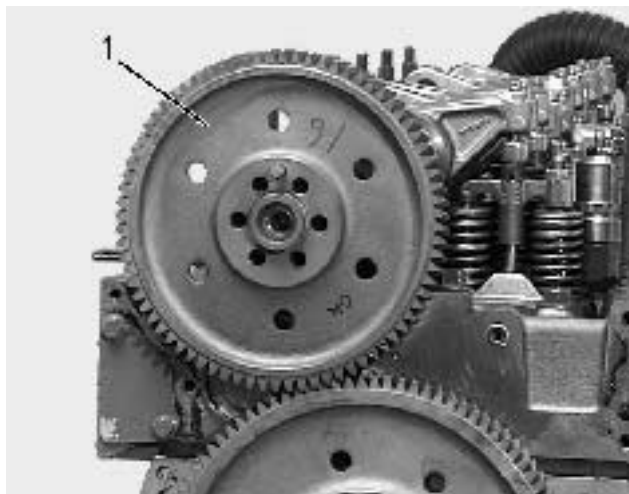
Remove the polygon hub using puller 884994 and 6 pcs of M10x60 mm.

11

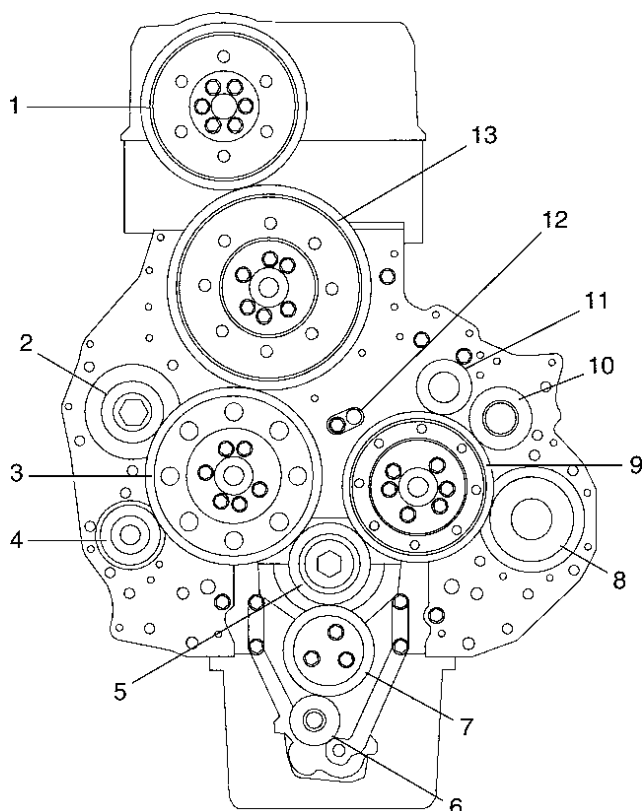


Remove the toothed wheel.

12



Remove the camshaft gear (1) using a puller.



The numbering of the gears in the illustration refers to the text.

13

Remove the intermediate gears (3) and (9) from the timing plate and the cylinder head's intermediate gear (13).

14

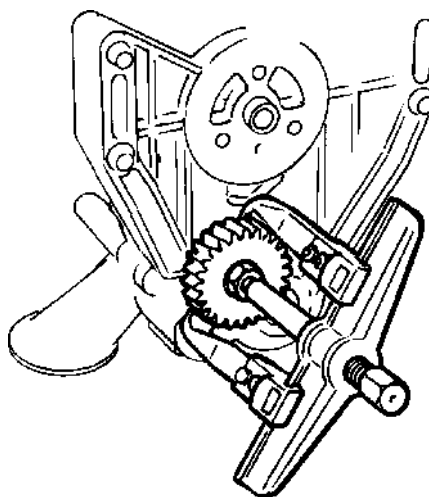


Remove the crankshaft gear (5) with a suitable puller.

15

Remove the intermediate gear (7).

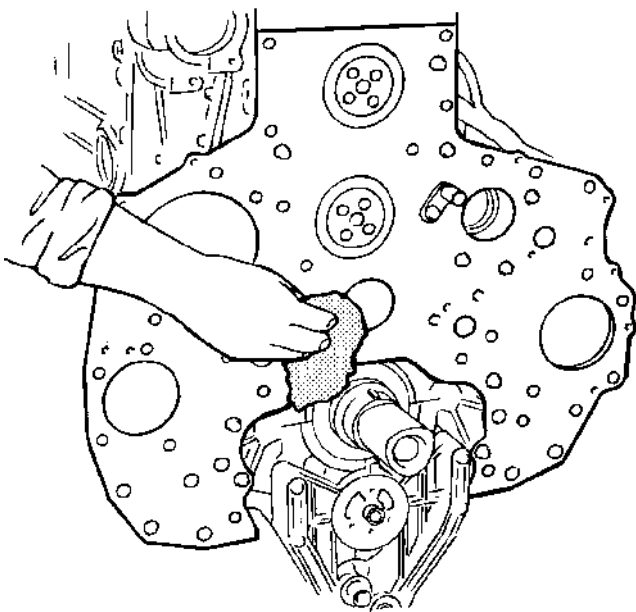
16



Make a punch mark in the center of an M12x20 mm bolt as a guide for the puller. Then place it in the shaft for the oil pump gear (6). Pull the gear off with a puller.

Cleaning, checking

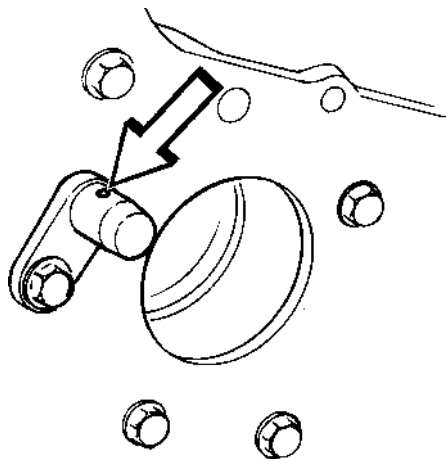
17



Clean the timing plate and the front of the cylinder head.

NOTE: The timing plate should not be removed unless absolutely necessary.

18



Remove the oil nozzle from the timing plate and check that the holes are not clogged. Refit the oil nozzle.

19

Check that the keyway in the crankshaft is undamaged. Make sure that the key is correctly positioned in the groove.

Timing plate, removing/fitting

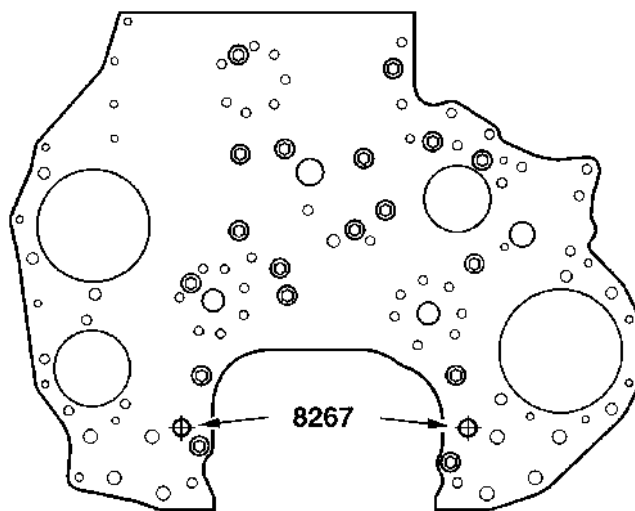
Fitting/removing the timing plate on an existing engine block is described in Alternative 1.

NOTE: The timing plate should not be removed unless absolutely necessary.

New engine blocks supplied as a spare part are shipped without a timing plate. The method in Alternative 2 describes mounting of the timing plate on a **new** engine block.

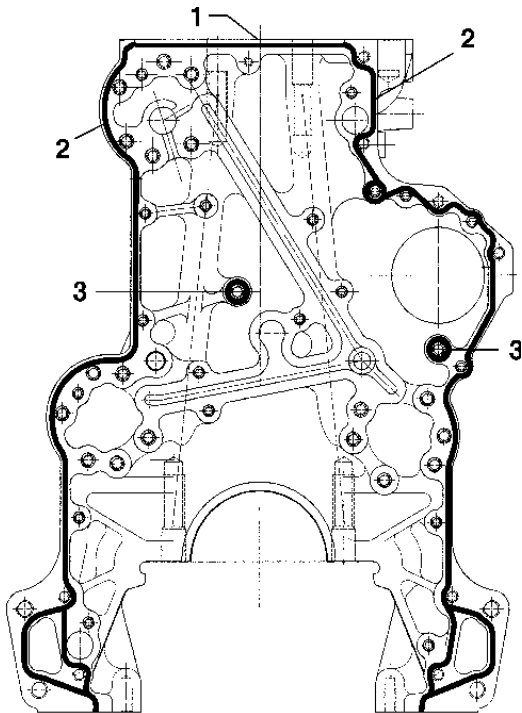
ALT. 1

20



Mount two guide pins 9998267 so that they are secured in the engine block through the timing plate. Remove the timing plate. The guide pins should remain in place.

21

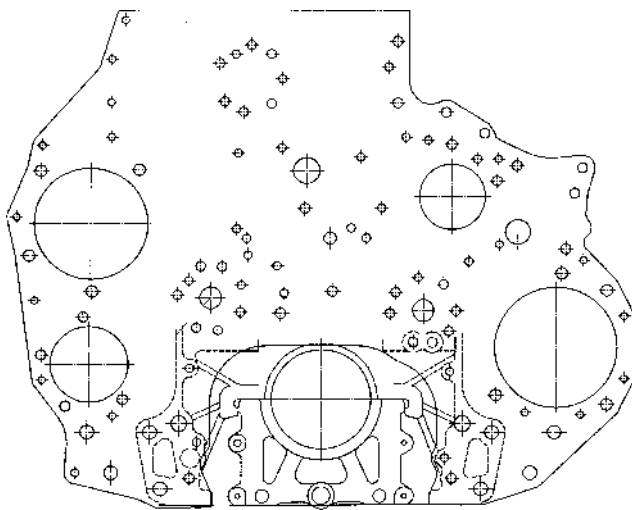


The sealant should be applied 4 mm from the edge of the engine block. Where no hole radius is specified, the sealant should be applied with a radius of 8 mm from the center.

Apply a 1 mm thick bead of sealant, part no. 1161231-4, at (1) on the engine block. Apply a 2 mm thick bead of sealant all round the engine block (2) and at the hole (3).

NOTE: The timing plate must be fitted within 20 minutes as the sealant will then harden.

22



Fit the timing plate, which is guided into position by the previously fitted guide pins 9998267. Tighten to 34 ± 4 Nm.

ALT. 2

23

Fit the timing plate loosely on the new engine block. Adjust the timing plate so that it is level with the bottom of the engine block.

NOTE: Do not apply sealant at this stage.

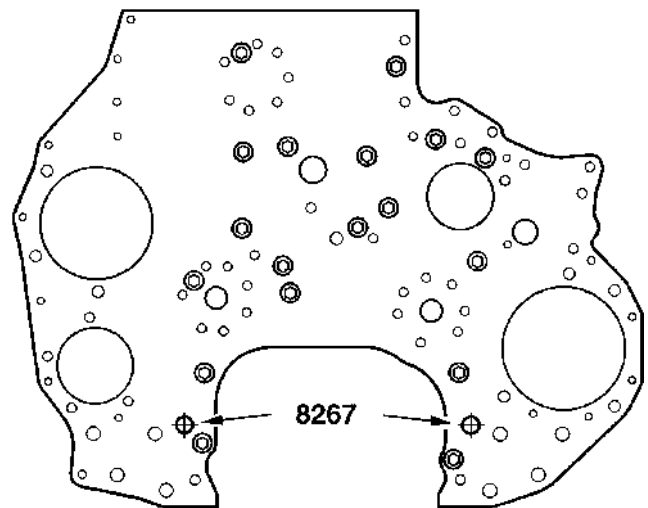
24

Fit the two (fixed) intermediate gears on the timing plate.

25

Adjust the timing plate laterally so that the backlash to the crankshaft gear is the same for both intermediate gears. Fit dial indicator 9999683 in magnetic stand 9999696. **Adjust and check until the backlash is the same for both intermediate gears.**

26

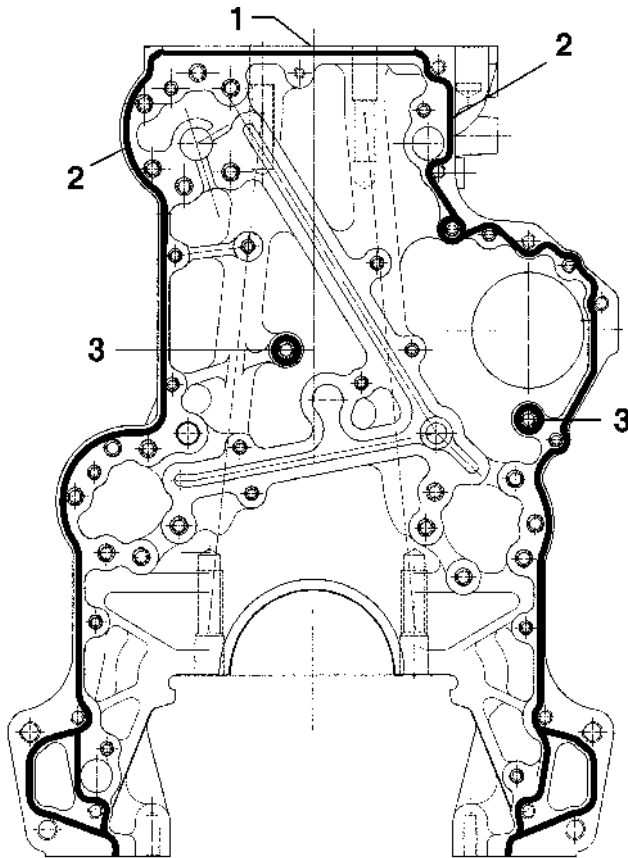


Secure the timing plate with a few bolts. Insert two guide pins 9998267 so that they are secured in the engine block through the timing plate.

27

Remove the timing plate.

28

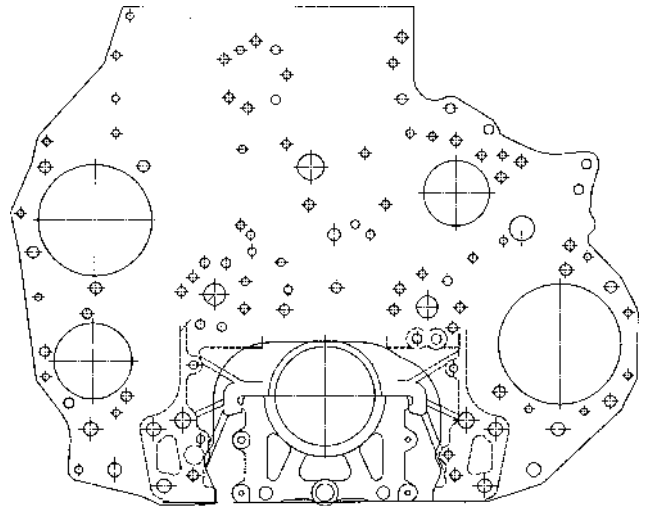


The sealant should be applied 4 mm from the edge of the engine block. Where no hole radius is specified, the sealant should be applied with a radius of 8 mm from the center.

Apply a 1 mm thick bead of sealant, part no. 1161231-4, at (1) on the engine block. Apply a 2 mm thick bead of sealant all round the engine block (2) and at the hole (3).

NOTE: The timing plate must be fitted within 20 minutes as the sealant will harden.

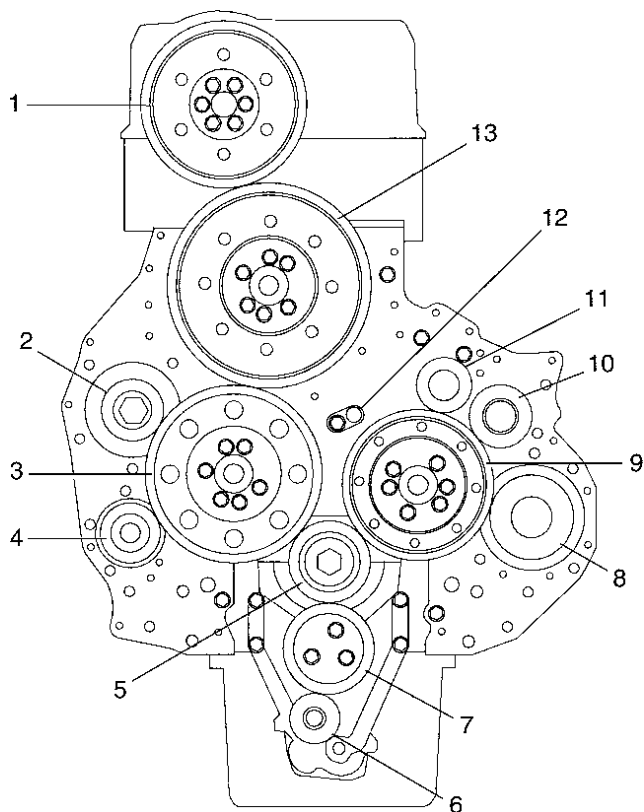
29



Fit the timing plate, which is guided into position by the previously fitted guide pins 9998267. Tighten to 34 ± 4 Nm.

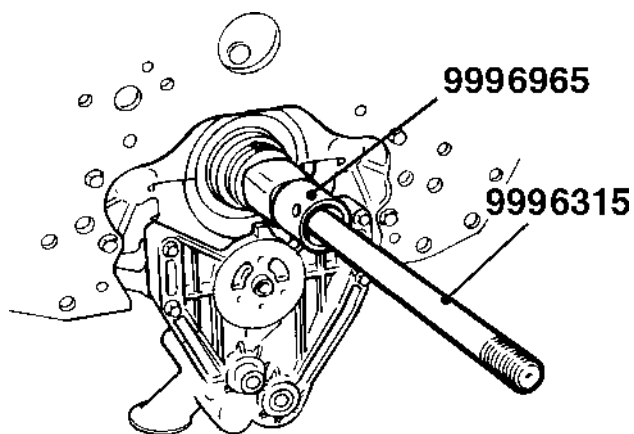
Fitting the timing gears

30



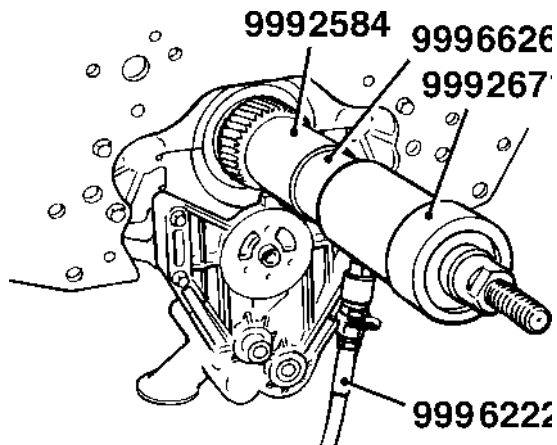
The numbering of the gears in the illustration refers to the text.

31



Fit adapter 9996965 and spindle 9996315 in the crankshaft journal.

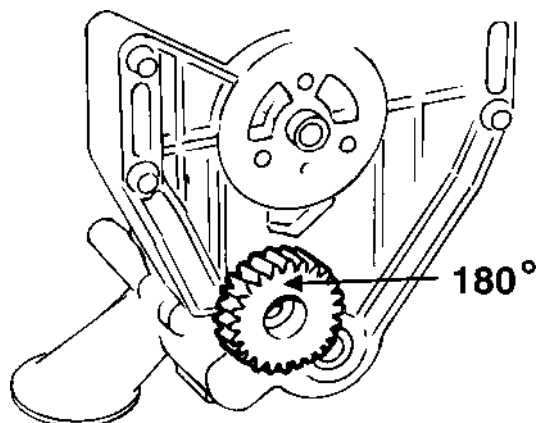
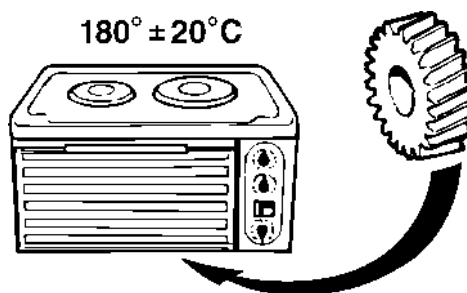
32



NOTE: Heat the crankshaft gear to approx. 100°C (212°F).

Place the new heated crankshaft gear (5) on the spindle. Fit adapters 9992584 and 9996626. Fit hydraulic cylinder 9992671. Fit the nut on the spindle and tighten it. Connect foot pump 9996222 to the hydraulic cylinder and press on the heated crankshaft gear.

33



Heat the oil pump gear to approx. 180°C (356°F) and tap it onto the oil pump using a plastic mallet.

34

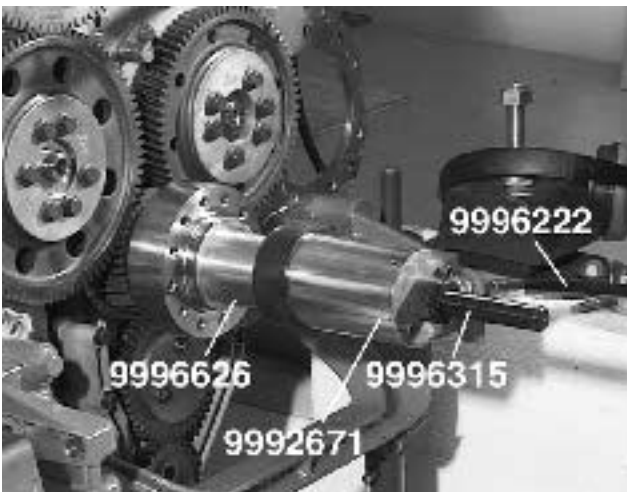
Oil the plain bearing, fit the intermediate gear (7) and tighten to 24 ± 4 Nm.

Oil the plain bearings for intermediate gears (3) and (9). Fit and tighten to 15 ± 3 Nm. Then angle tighten to $120^\circ \pm 5^\circ$.

NOTE: Use new bolts when refitting the intermediate gears.

35

Fit the cylinder head's adjustable intermediate gears (13). **Tighten the bolts by hand until they bottom against the bearing bracket.**

**36**

Place the heated polygon hub on spindle 9996315. Fit adapter 9996626 and hydraulic cylinder 9992671. Fit the nut on the spindle and connect foot pump 9996222 to the hydraulic cylinder. Press on the polygon hub.

NOTE: Heat the polygon hub to approx. 100°C (212°F).

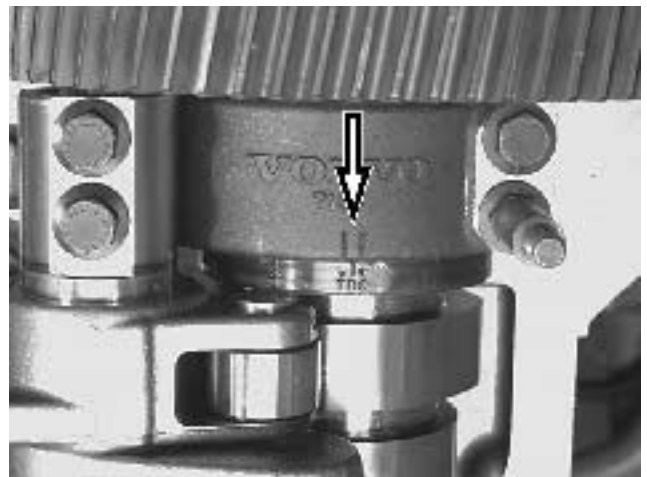
37

Secure turning tool 9993590 to the engine block with a ratchet wrench. Fit the crankshaft bolt together with the washer and tighten to 645 ± 25 Nm.

NOTE: Allow the parts to cool to room temperature before tightening.

38

Check that the 0° mark on the flywheel is opposite the arrow on the flywheel housing.

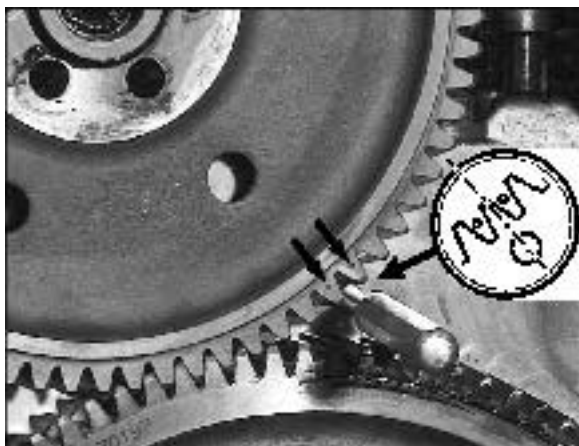
39

Make sure that the camshaft marking for top dead center (TDC) is between the markings on the bearing cap.

40

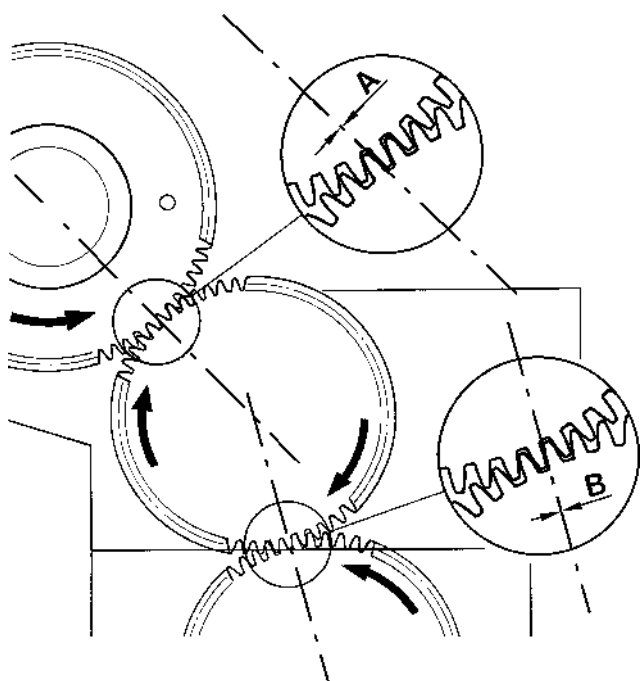
Fit the camshaft gear without the vibration damper. Use suitable sockets (see illustration) so that the bolts can be tightened down hard.

41

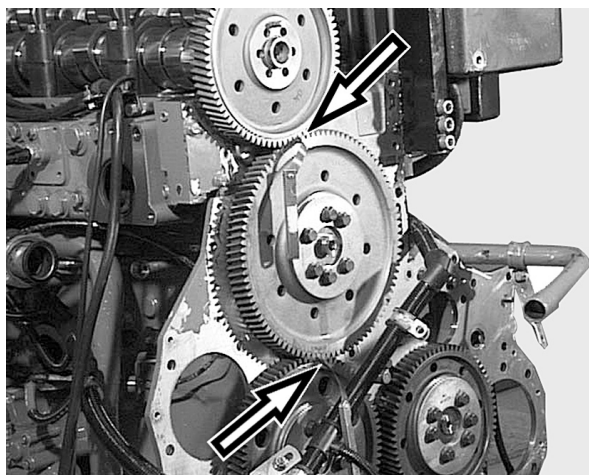


Check that the camshaft gear is correctly mounted by inserting a 7 mm dowel in the hole (see illustration). Make sure that the dowel is between the two marks on the camshaft gear.

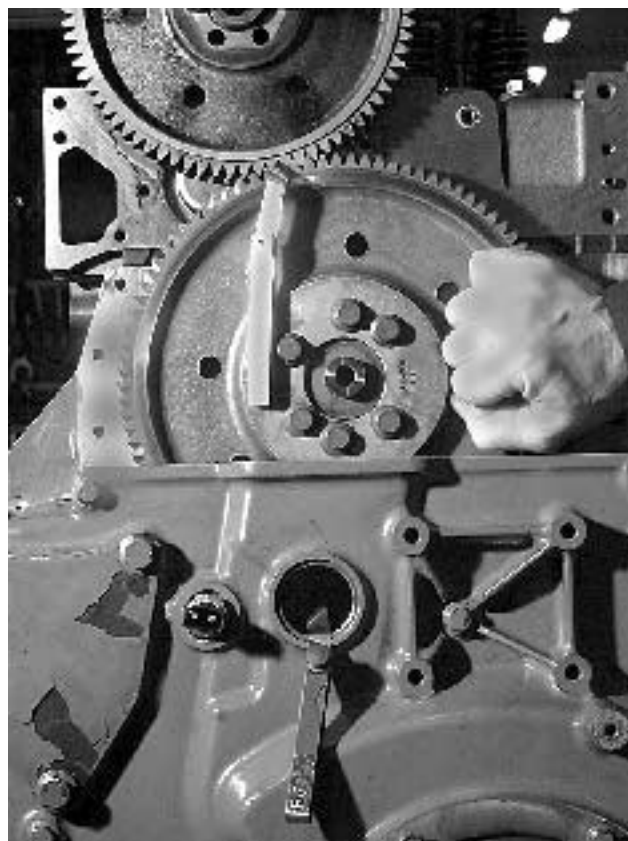
42



Check the adjustable intermediate gear's flank clearance in mesh with the two gears **A** and **B**. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE". Use two feeler gauges to check the flank clearance.

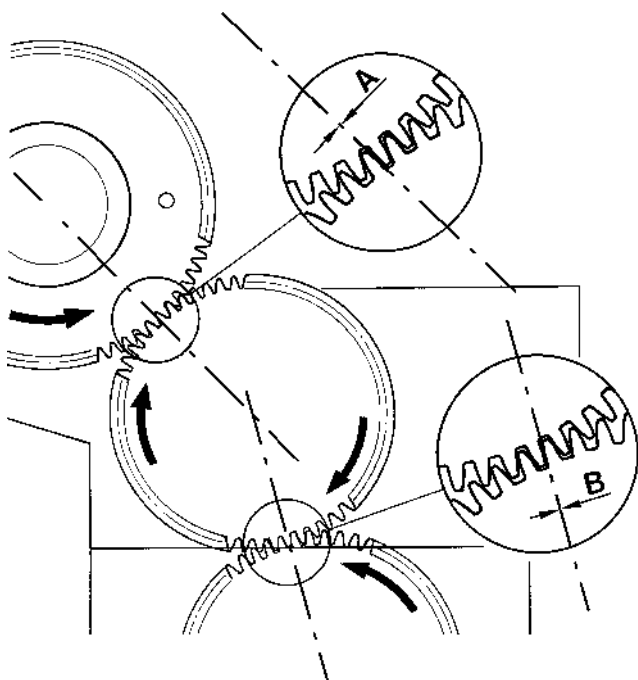


The illustration shows checking on a removed timing cover.



Checking with the lower timing cover fitted is done through the inspection hole.

43



Adjust the flank clearance as follows: Undo the adjustable intermediate gear bolts.

Insert two 0.10 mm feeler gauges in positions **A** and **B** and rotate the camshaft in the direction of the arrow.

44

Tighten the bolts on the adjustable intermediate gear lightly and check that both feeler gauges meet with the same resistance. Then remove the feeler gauges. Tighten the adjustable gear to the specified torque according to the tightening diagram. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

45



Checking method with lever type dial indicator.

Place lever type dial indicator 9999683 in magnetic stand 9999696 and bring the tip of the indicator up against a tooth on the adjustable intermediate gear.

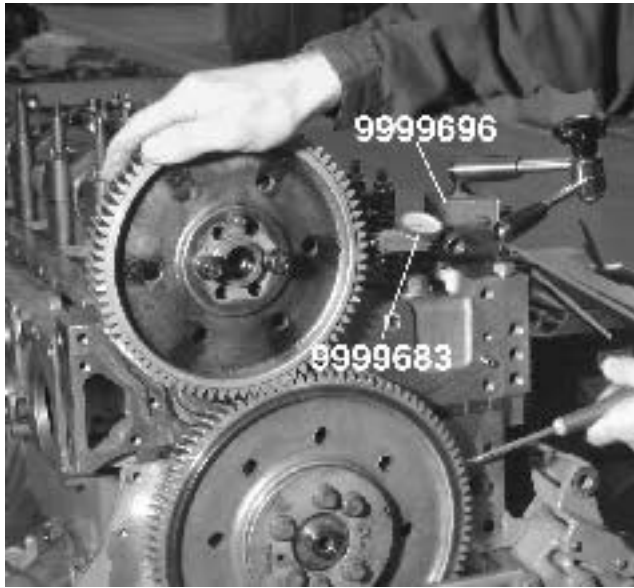
NOTE: The tip of the lever type dial indicator should be at right angles to the tooth.

46



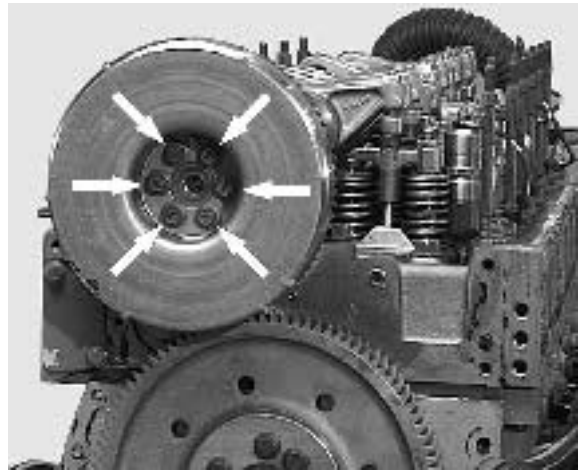
Turn the adjustable intermediate gear clockwise. Check the flank clearance of the intermediate gear by turning the lower gear back and forth. Note the reading.

47



Transfer the lever type dial indicator to the camshaft gear. Secure the adjustable intermediate gear by means of a screwdriver. Check the clearance to the adjustable gear by turning the camshaft gear back and forth. Compare the flank clearances with those given in the specification. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

48



Remove bolts and sleeves from the camshaft gear. Fit the toothed wheel on the camshaft gear. Tighten the vibration damper to 35 ± 3 Nm and then angle tighten to $90^\circ \pm 5^\circ$.



IMPORTANT! If the toothed wheel or any of its teeth are damaged or deformed, it must be changed. The same applies if any of the holes for the toothed wheel retaining bolts are damaged.

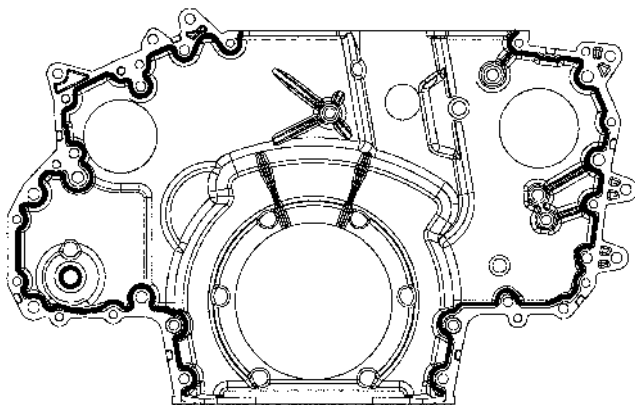
49

Fit the inner vibration damper, the O-ring on the hub and the driver. Tighten the two socket cap screws to 60 ± 5 Nm and then angle tighten to $90^\circ \pm 5^\circ$.

50

Fit the dust excluders and holder for the crankshaft sealing ring.

51



Apply an even bead (2 mm) of sealant, part no. 11612777 in the marked area (see illustration).

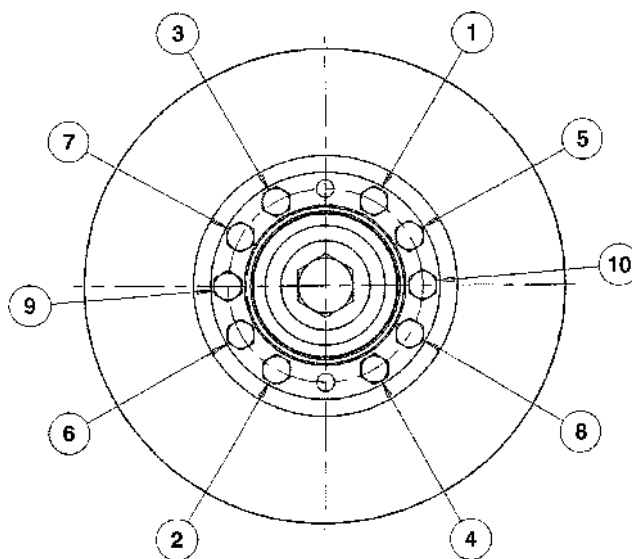
The lower timing cover must be fitted within 20 minutes as the sealant will harden.

⚠ WARNING! The lower timing cover is heavy. Two persons will be necessary to fit it in place.

52

Fit the drive take-off, generator and fuel pump.

53

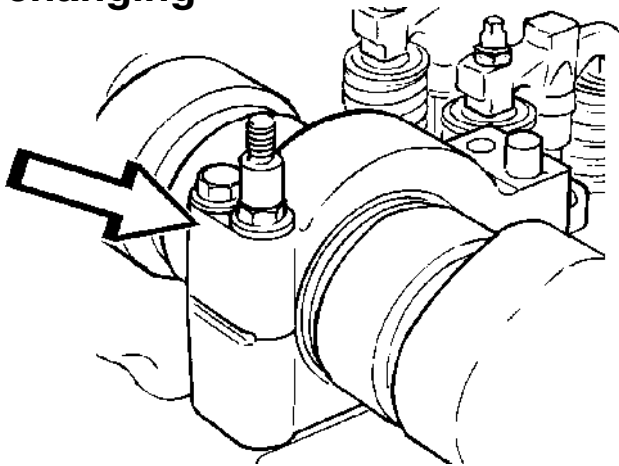


Fit the outer vibration damper. Tighten to 60 ± 5 Nm and then angle tighten to $90^\circ \pm 5^\circ$ as specified in the tightening diagram.

54

NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the cover.

Bearing housing for camshaft, changing

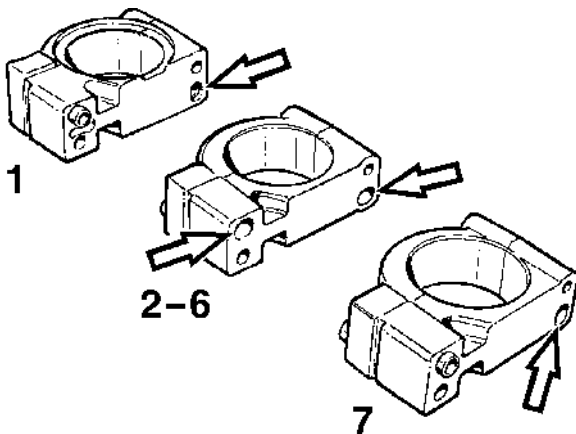


The production-fitted bearing housings are machined together with the cylinder head and therefore cannot be transferred from one cylinder head to another.

If a bearing housing is damaged, an exchange housing can be fitted in its place. **All bearing housings should then be changed to ensure that the bearing housing seats can be aligned.**

The holes for the guide sleeves in the exchange bearing housings are oval so that the center bearing housing can be adjusted radially and the front and rear housings axially.

If the cylinder head is already fitted with exchange housings, a damaged bearing housing can be changed without changing the other housings.



The exchange housings are recognizable by their oval holes for the guide sleeves.

If exchange housings are fitted, mark them with numbers so that they can be refitted in the same place if they have been removed.

Camshaft, changing

Special tools: 9993590, 9998255, 9998264, 9998602, 9998628

Prior conditions:

Radiator assembly removed. See "Radiator element, changing".

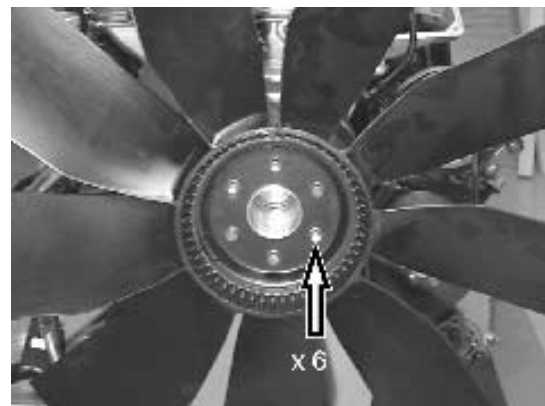
1

Turn off the power by means of the main switch (switches) and check that no current is supplied to the engine.

2

Remove the protective plates round the drive belts.

4



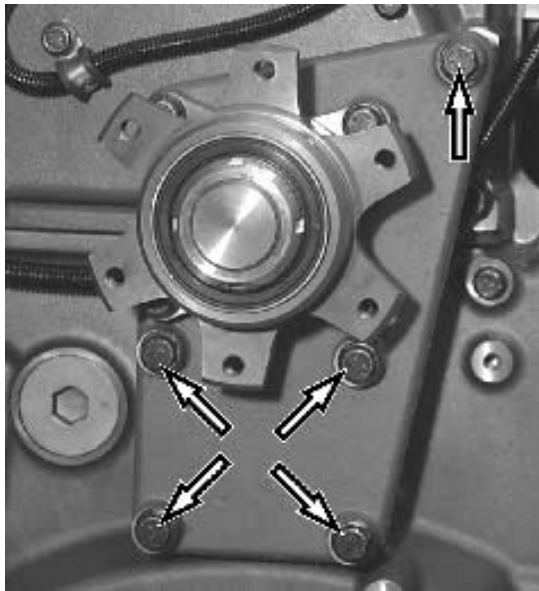
Remove the radiator fan (six studs) and remove the drive belt. See "Drive belts, changing".

5



Remove the spacer and pulley.

6

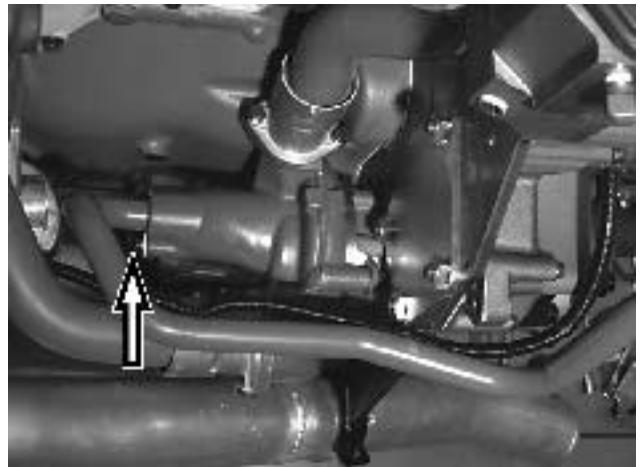


Remove the radiator fan drive.

7

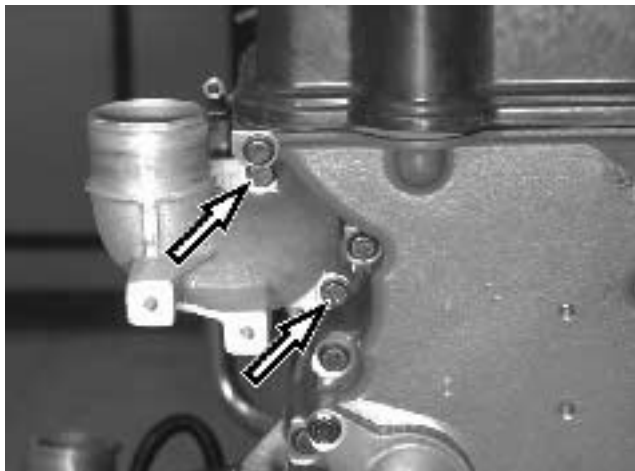
Undo the clamps on the hose between the pipes to the crankcase breather and pull the hose to the left.

8



Detach the water pipe from the coolant pump and radiator hose connection.

9

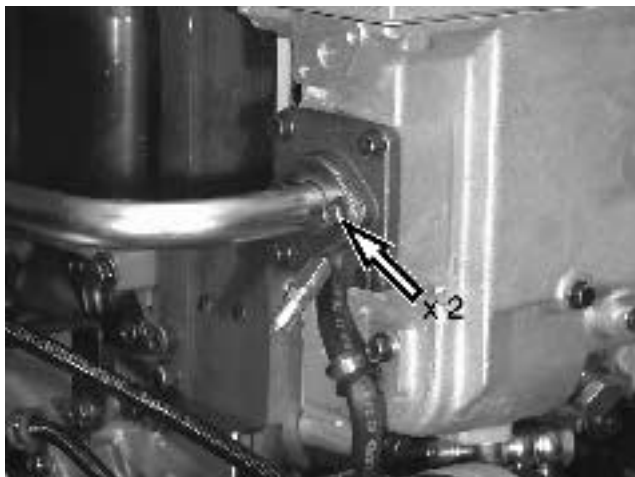


Remove the upper radiator hose connection from the cylinder head.

10

Remove the front engine lifting bracket.

11 (TWD)



Remove the front water pipe between the charge air cooler and the radiator hose connection.

12

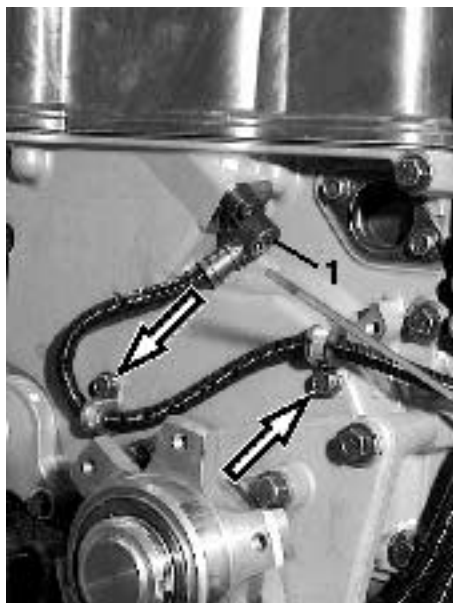


Remove the exhaust pipe at the turbocharger.

13

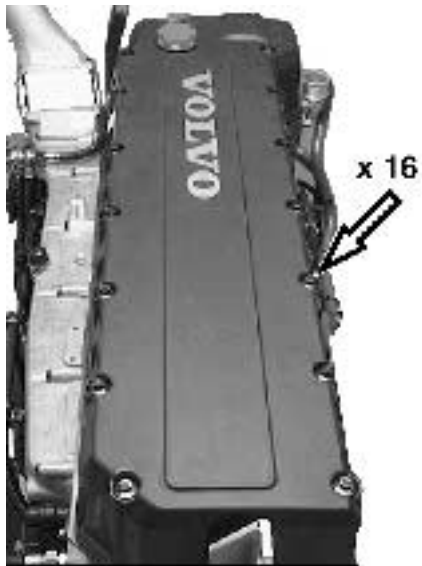
Remove the heat shield (three bolts) from the cylinder head at the turbocharger.

14



Remove the camshaft position sensor (1) and the clamps.

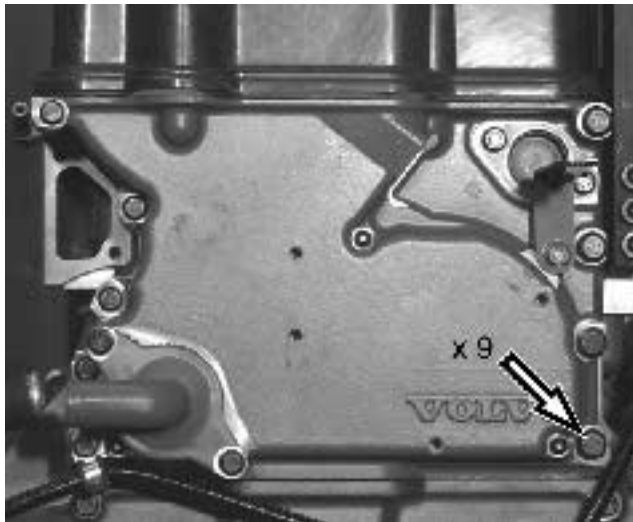
15



Remove the valve cover nuts using an ordinary ratchet wrench and remove the valve cover.

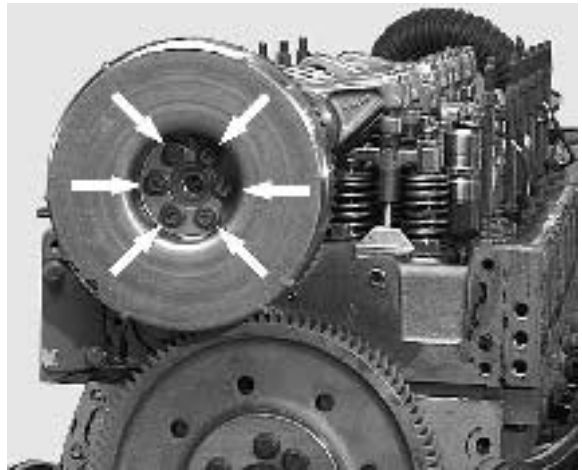
NOTE: Do **not** use air-assisted tools when removing the valve cover as this could damage the unit injector wiring harness and the studs.

16



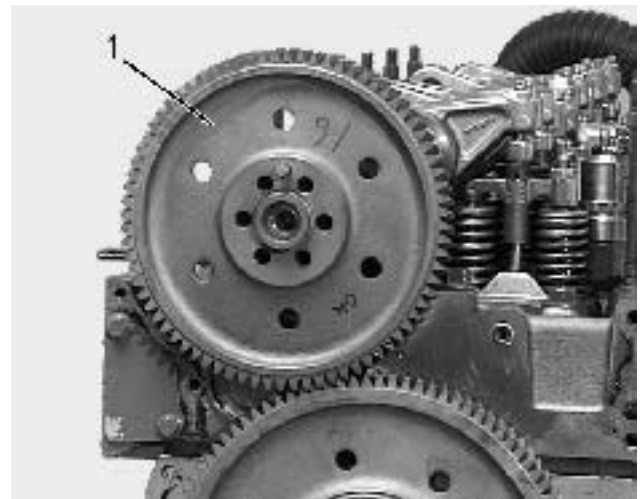
Remove the upper timing cover.

17



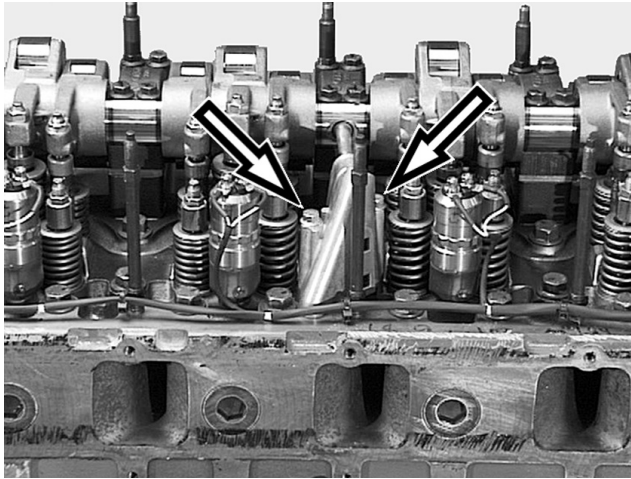
Remove the toothed wheel.

18



Remove the camshaft gear (1). Use a suitable puller if necessary.

19

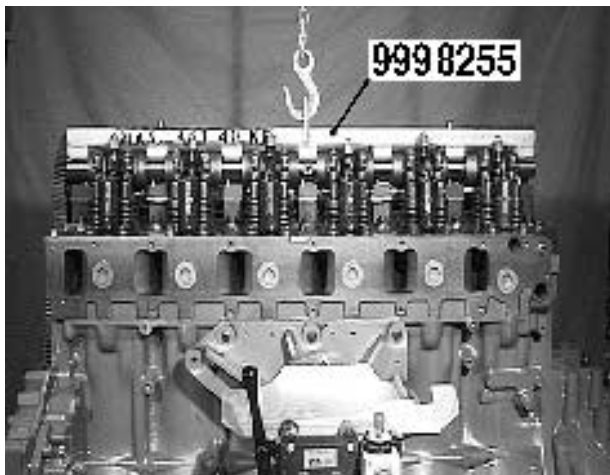


Remove the oil pipe connected to the rocker arm bridge.

20

Undo the rocker arm bridge retaining bolts evenly over the entire bridge to avoid uneven stress.

21



Lift away the rocker arm bridge using lifting tool 9998255.



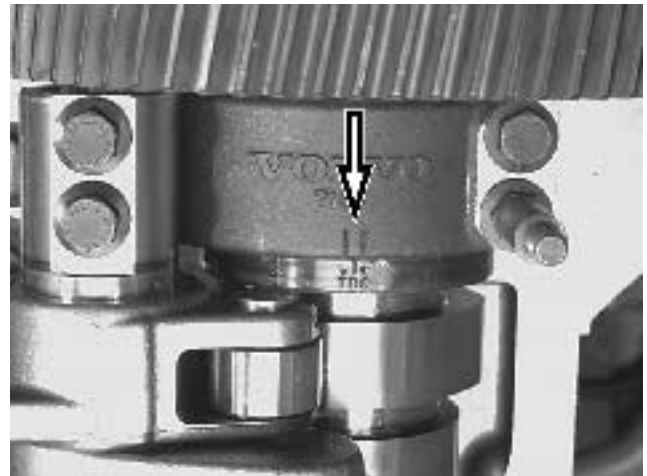
WARNING! To avoid injury and material damage, the rocker arm bridge should be lifted away by two persons if no lifting device is available. The rocker arm bridge weighs about 27 kg (60 lbs).

22



Fit turning tool 9993590.

23



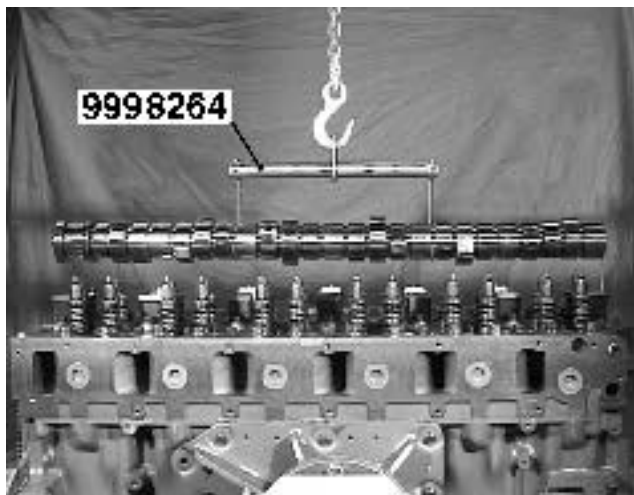
Rotate the flywheel until the piston in cylinder no. 1 is at top dead center 0° on the flywheel and the camshaft marking is midway between the marks on the bearing cap.

24

Check that the camshaft bearing caps are factory marked 1–7 in accordance with the relevant bearing bracket. Remove the camshaft bearing caps by tapping them carefully with a rubber mallet. Keep the camshaft bearing caps and bearing halves together in a suitable place with the bolts in the order they were removed and will later be refitted.

NOTE: The camshaft bearing caps are held in place with guide pins.

25

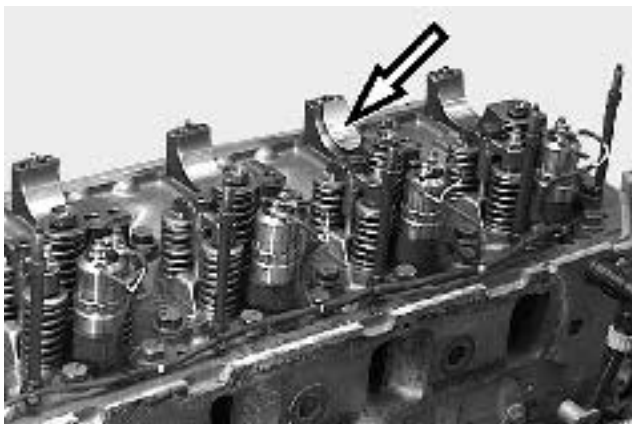


Lift the camshaft away using lifting tool 9998264.

⚠ WARNING! Bear in mind that the camshaft cams are extremely sharp.

⚠ WARNING! To avoid injury and material damage, the camshaft should be lifted away by at least two persons if no lifting device is available. The camshaft weighs about 35 kg (77 lbs).

26



Remove the lower bearing halves.

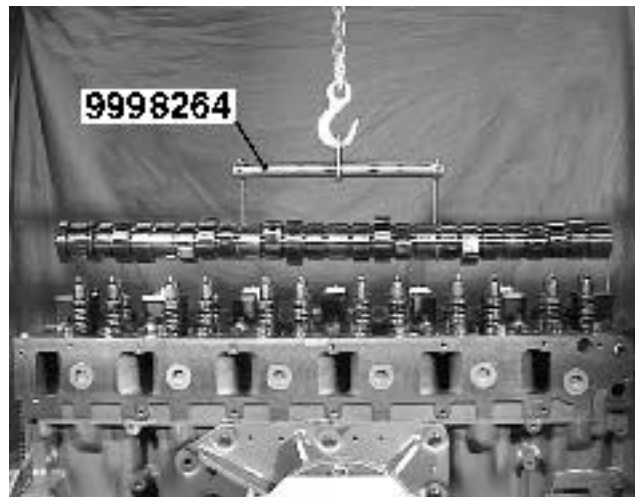
27

Fit new camshaft bearing shells in the bearing brackets and caps as necessary. Make sure that bearings of the correct size are used and that they are fitted correctly in their seats.

28

Lubricate the bearing surfaces with engine oil.

29

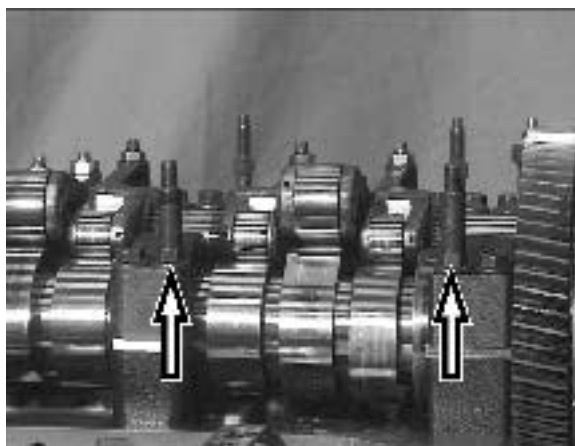


Carefully lift the camshaft into position using lifting tool 9998264.

⚠ WARNING! Bear in mind that the camshaft cams are extremely sharp.

⚠ WARNING! To prevent injury and material damage, the camshaft should be lifted into place by at least two persons if no lifting device is available. The camshaft weighs about 35 kg (77 lbs).

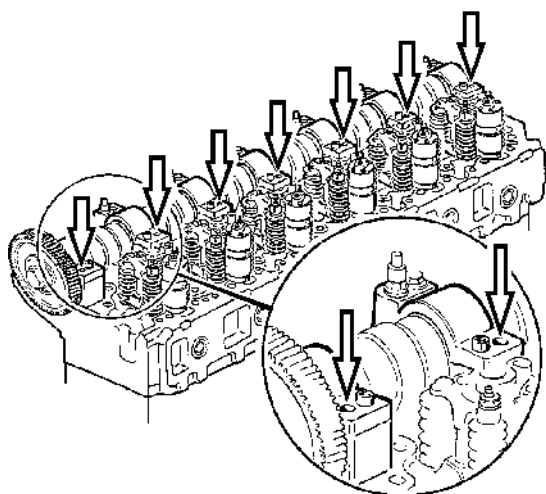
30



NOTE: See the location of the bearing cap bolts at far right. Fit the remaining bolts as on the bearing cap to the left

Fit the caps on the relevant bearing brackets. Fit the bolts but do not tighten them.

31

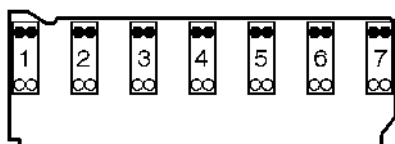


Insert 7 bolts (M10 x 90) in the holes for the rocker arm bridge having no guide sleeves. Tighten these bolts to M10 standard torque.

32

1.

$15 \pm 5 \text{ Nm}$
 $+ 90^\circ \pm 5^\circ$



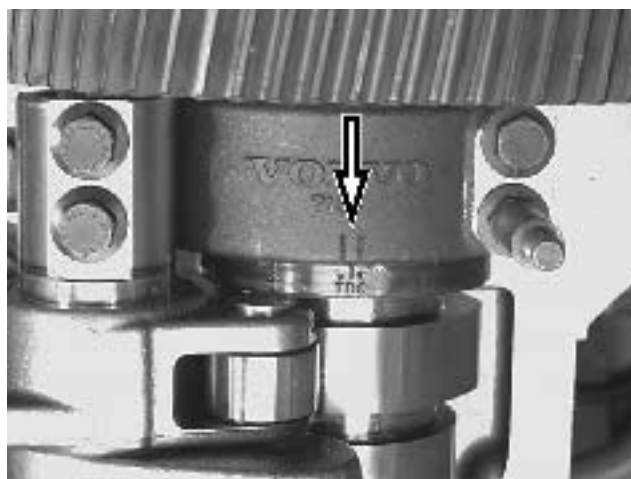
33



Rotate the flywheel using turning tool 9993590 until the 0° mark is opposite the arrow.

NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the covers.

34



Check that the camshaft marking for top dead center (TDC) is midway between the markings on the bearing cap.

35



Fit the camshaft gear and use suitable sockets so that the bolts can be tightened down hard.

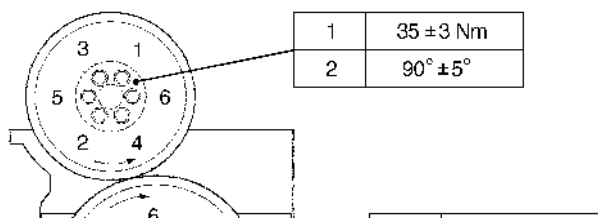
36

Check or adjust the flank clearance according to the instructions under the heading "Timing gear, changing".

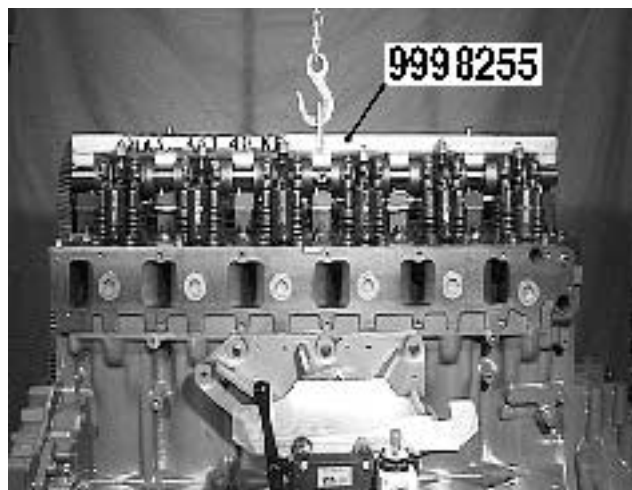
37

Fit the toothed wheel and tighten according to the tightening diagram below.

⚠ IMPORTANT! If the toothed wheel or any of its teeth are damaged or deformed, it must be changed. The same applies if any of the holes for the toothed wheel retaining bolts are damaged.



38



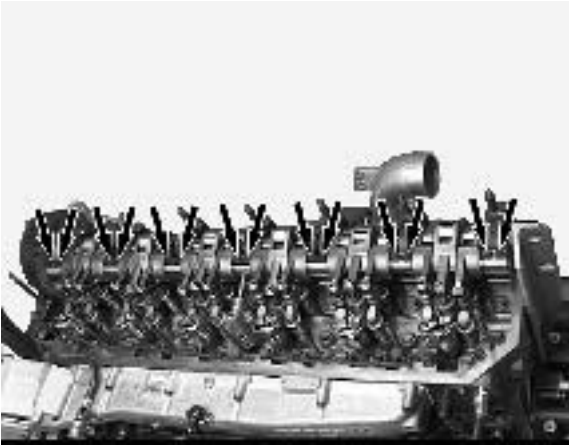
NOTE: Loosen all adjusting screws for the valves and unit injector before fitting the rocker arm.

Oil the valve yokes and camshaft cams with engine oil. Lift the rocker arm bridge into place using 9998255. Check that the valve yokes and rocker arms are correctly positioned relative to each other.



WARNING! To avoid injury and material damage, the rocker arm bridge should be lifted away by two persons if no lifting device is available. The rocker arm bridge weighs about 27 kg (60 lbs).

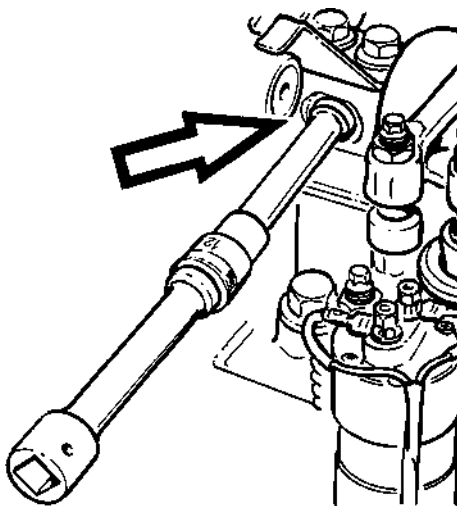
39



Fit the rocker arm bridge bolts and tighten them by hand.

Tighten the retaining bolts for the rocker arm bridge and camshaft bearing caps to the torque specified in the tightening diagram. See "Cylinder head, fitting" step 26.

40



Mount the oil pipe for the rocker arm shaft. Wipe all oil off the oil pipe, making sure it is completely dry. Oil the hole in the rocker arm bridge.

Use a 1/2" short extension bar and a 12 mm socket. Insert the pipe in the socket and fit a new seal on the other end of the pipe.

Press the pipe into the rocker arm bridge. Make sure that the sealing ring ends up in the right place.

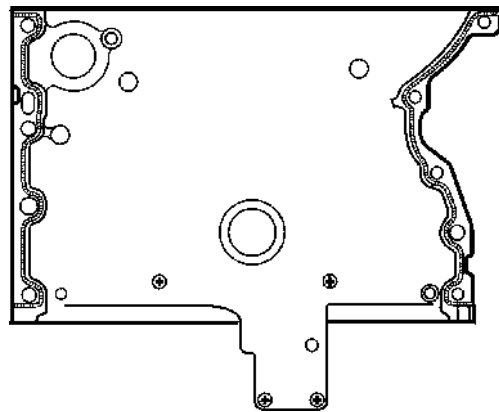
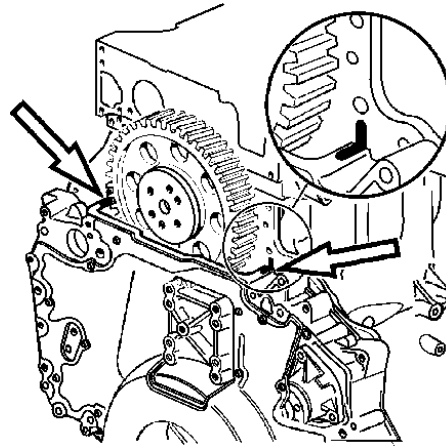
41

Adjust the valves and unit injectors. See "Valves and unit injectors, adjusting".

42

Clean the upper timing cover and the contact surfaces.

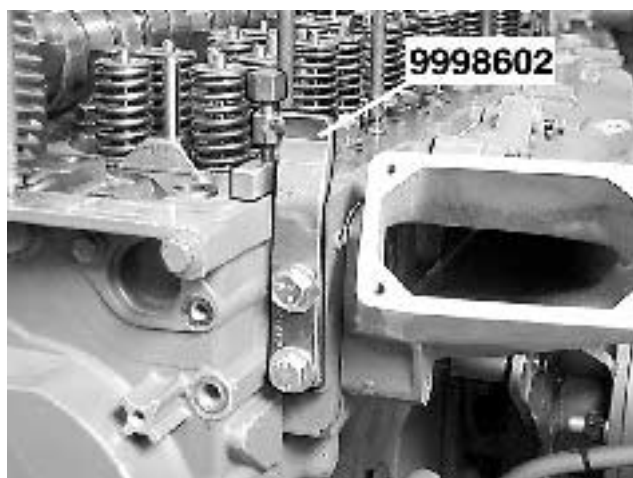
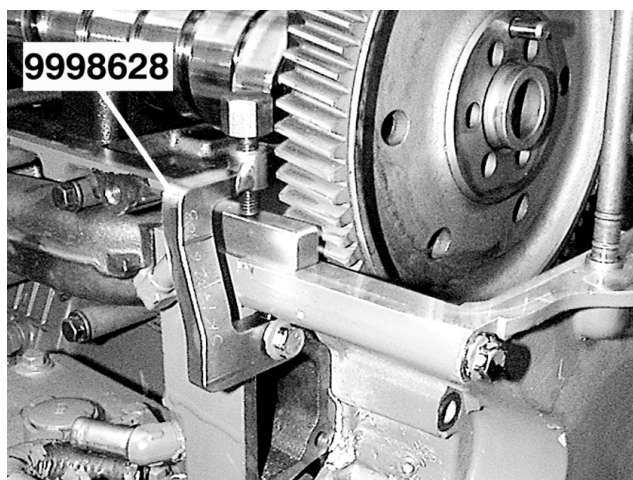
43



Apply a 2 mm thick bead (see illustration) of sealant, part no. 11612314, to the timing cover and in the corners between the lower timing cover and the timing plate.

NOTE: The timing cover must be fitted within 20 minutes of applying the sealant.

44

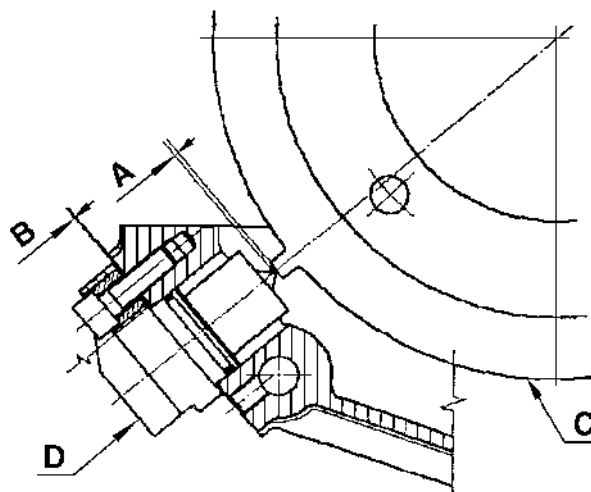


Fit the upper timing cover. Insert the bolts in the cover's slotted holes. Tighten the bolts finger-tight but not to the specified torque.

Fit press tools 9998602 and 9998628. Screw the tools down so that the seal face of the timing cover against the valve cover is level with the seal face on the cylinder head. Fit the other bolts and tighten to the specified torque. See "Cylinder head, fitting" step 33.

NOTE: Leave the press tools in place. Allow the sealant to solidify for about 30 minutes. Do not forget that one of the bolts also secures the radiator fan drive.

45



A = clearance mm

C = toothed wheel

B = shim

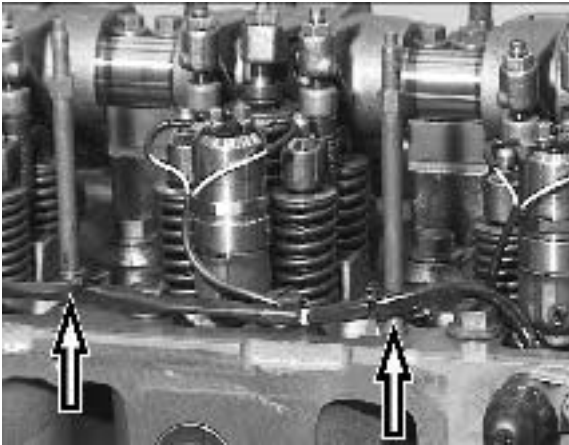
D = camshaft position sensor

Rotate the flywheel until a tooth on the camshaft's toothed wheel is opposite the sensor's hole in the timing cover. Fit the camshaft position sensor and measure the distance **A** using a feeler gauge between the sensor's tip and the toothed wheel. Permissible clearance **A**: 0.6 ± 0.4 mm. To obtain a correct signal from the camshaft position sensor, the clearance between the sensor and toothed wheel must lie within these limits. Adjust the sensor by means of shims in accordance with the table below.

A	B	
Measured clearance	Shim	
	Quantity	Part no.
0.2–1.0 mm	–	–
–0.3 till 0.3 mm	1	1677894
–0.6 till –0.3 mm	2	1677894

NOTE: Do not forget to fit the two clamps on the camshaft position sensor wiring.

46



Clean the threaded holes for the removed studs in the cylinder head. Clean the studs, coat them with Volvo Penta locking fluid 1610532 and tighten them to 40 ± 3 Nm.

Fit the wiring by means of straps round the studs.

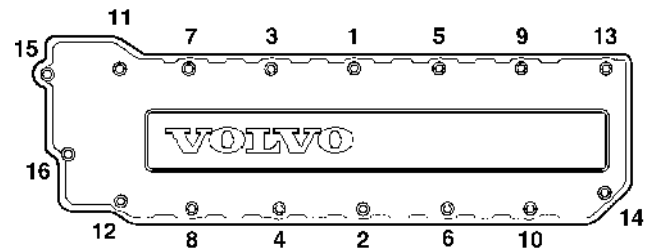
⚠ IMPORTANT! Meticulously wipe off all surplus locking fluid after tightening the studs.

47

Apply a 2 mm thick bead of sealant, part no. 11612314, in the joint between the upper timing cover and the cylinder block.

NOTE: The valve cover must be fitted within 20 minutes of applying the sealant.

48



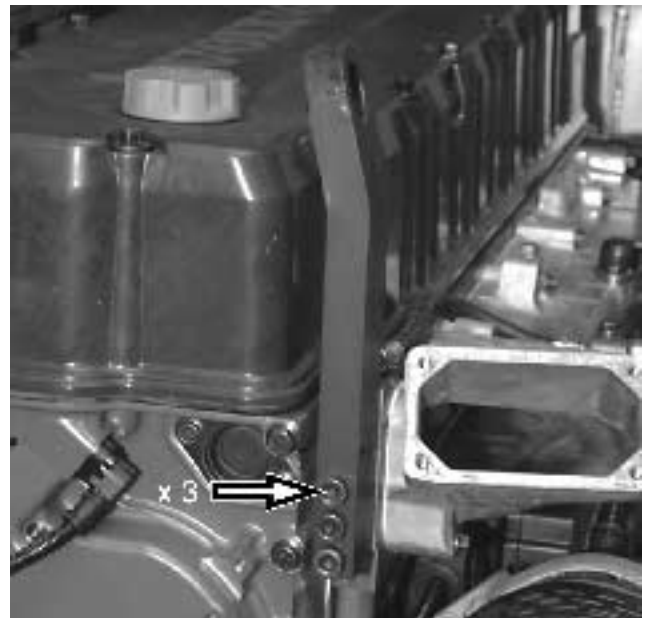
Fit the valve cover and tighten the bolts to 20 ± 2 Nm according to the tightening diagram.

NOTE: Do **not** use air-assisted tools when fitting the valve cover as this could damage the studs and the unit injector wiring harness.

NOTE: It is important that the valve cover bolts are tightened to the torque specified in the diagram to prevent cracks in the cover and loosening of the studs.

If any of the valve cover studs loosened from the cylinder head when the bolts were removed, the wiring harness to the unit injectors must be checked. The wire holder on the stud may have followed in the rotation and damaged the wiring harness.

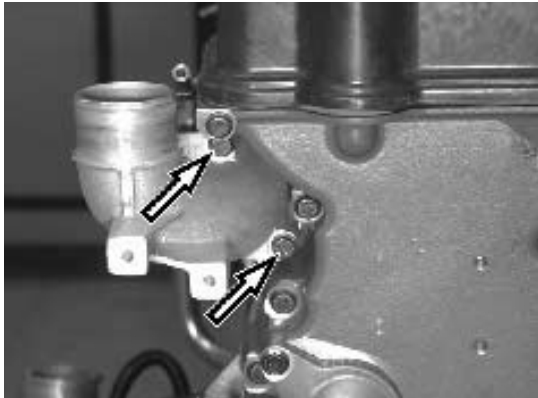
49



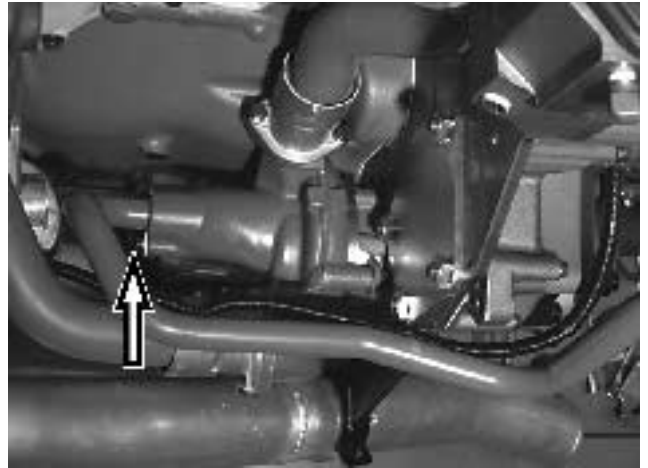
Fit the front engine lifting bracket.

50

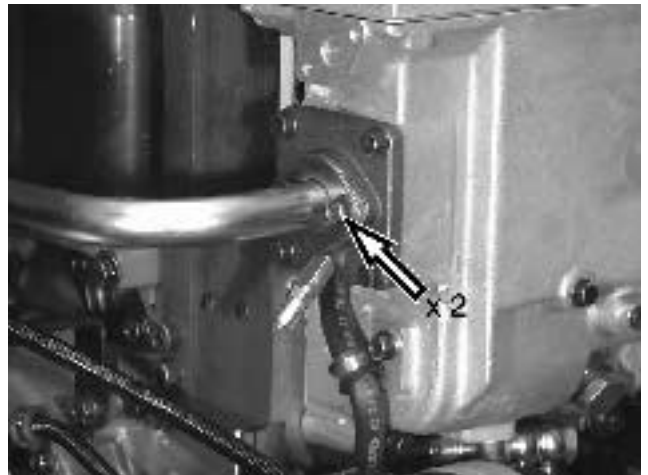
Pull the hose between the pipes to the crankcase breather and secure the clamps.

51

Mount the upper radiator hose connection on the cylinder head with new seals.

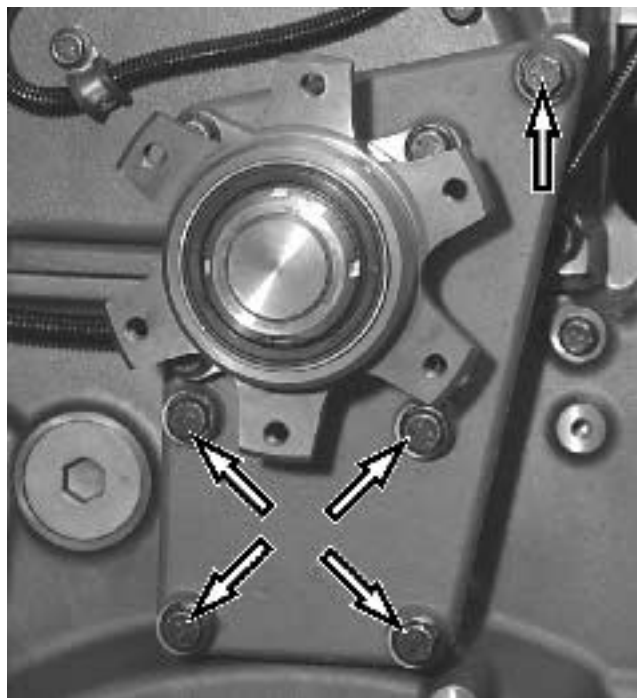
52

Fit the water pipe to the coolant pump and the radiator hose connection using a new seal.

53 (TWD)

Fit the front water pipe between the charge air cooler and the radiator hose connection.

54



Fit the radiator fan drive.

NOTE: The upper bolt also secures the upper timing cover.

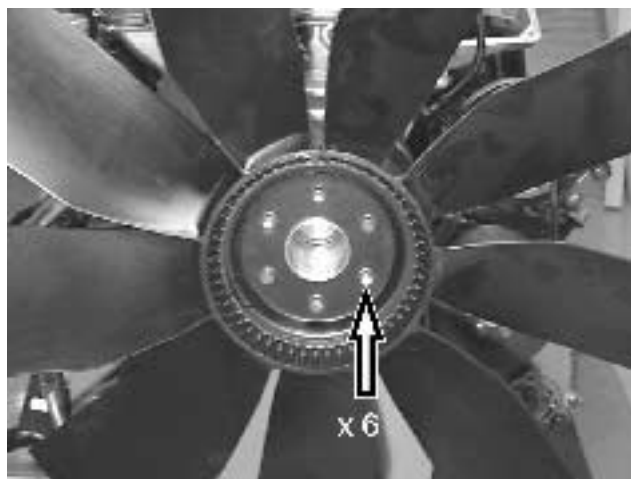
55



Fit the pulley and spacer.

NOTE: Center the holes for the studs with the pulley and spacer.

56



Fit the radiator fan (six studs) and drive belt. See "Drive belts, changing".

57

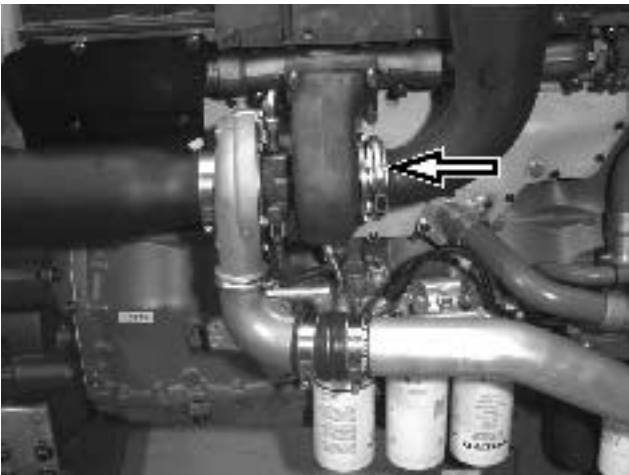
Fit the protective plates round the drive belts.

58

Fit the radiator assembly, see "Radiator element, changing".

59

Fit the heat shield on the cylinder head.

60

Fit the exhaust pipe on the turbocharger.

61

Fill up with the requisite quantities of oil and coolant. The coolant should be already mixed and of the correct quantity so that it will be known for certain that the cooling system is completely full.

62

Bleed the fuel system. See "Fuel system, bleeding".

63

Start the engine and perform a functionality check.

Camshaft, inspecting and reconditioning

See "Crankshaft, inspecting and reconditioning".

NOTE: The axial bearing surface of the camshaft must not be grinded.

See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE" regarding over-sizes of camshaft bearings.

Crankshaft, inspecting and reconditioning

The crankshaft is induction hardened

Inspecting

Inspect the crankshaft very carefully to avoid unnecessary reconditioning.

The following is involved in determining the need for reconditioning:

A. The crankshaft must be thoroughly cleaned. Measure the ovality, wear and conicity of the crankpins.

See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

B. Examine the bearing races for external damage. Any surface damage requires regrinding of the shaft.

C. Measure the longitudinal curvature (runout) of the crankshaft.

The shaft is placed in a pair of V-blocks under the main bearing journals of no. 1 and no. 7.

Or mount the crankshaft between centers.

The measurement should be taken on the fourth main bearing.

See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE" regarding max. permissible values.

Straightening of the crankshaft is not allowed.

D. Check for cracks both before and after grinding. Use magnetic powder to perform the check, i.e. fluorescent powder that is visible in ultraviolet light.

Reconditioning

1

Inspection as in A-D

2

Grinding to undersize in accordance with specifications. When grinding, it is important that hole fillet radii and transitions from hole fillet radii lie with given specifications.



IMPORTANT! Grinding of the center crankpin requires special attention as it concerns measurement "A". See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE", "broad axial bearing journal".

3

If grinding causes sharp edges to form at the inlet holes of the oil channels, they can be removed with a grinding pin or emery cloth.

4

Check that the shaft is free from grinding burns.

5

Check the longitudinal curvature (runout) of the shaft; see point C.

6

Check for cracks; see point D.

7

Overlapping of bearing races. Check that smoothness requirements for bearing races and radii are fulfilled. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

8

After grinding, the shaft, including oil channels, must be thoroughly cleaned from grindings and impurities. For efficient cleaning of all oil channels, the crankshaft is equipped with threaded plugs. The plugs are removed during cleaning and refitted afterwards.

Big-end bearings, changing all

Special tool: 9993590

Prior conditions:

Cylinder head and oil sump removed.

1



Fit turning tool 9993590 and rotate the flywheel until the big-end cap on connecting rods no. 1 and no. 6 come into position for removing the bolts.

2

Remove the big-end caps on connecting rods no. 1 and no. 6. Remove the bearing shells and clean the bearing seat in the connecting rod and cap.

NOTE: The bearing caps are numbered according to their respective connecting rod.

3

Inspect the crankpins and bearing shells. If any bearing has seized, the cause must be determined before new bearing shells are fitted.

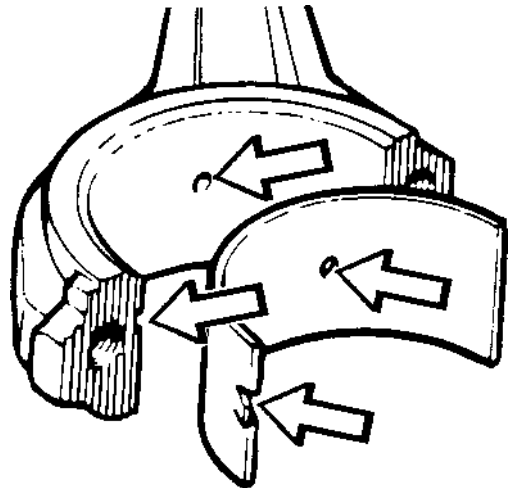
4

Check the dimensions of the crankpins in regard to maximum conicity and ovality. If any values exceed the maximum permitted, the crankshaft must be removed and remedied.

See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

If uncertain, also check whether the crankshaft is standard or undersize.

5



Fit new bearing shells, checking that they are of the right size. Make sure that the bearing shell guide pins are correctly located in the connecting rod big-end and that the oil holes in connecting rod and bearing shell coincide.

6

Oil the bearing shells and crankpins. Fit the bearing caps and tighten the bolts to 275 ± 12 Nm.

7

Rotate the flywheel until connecting rods no. 5 and 2 are in position and repeat points 2–6.

8

Rotate the flywheel until connecting rods no. 3 and 4 are in position and repeat points 2–6.

9

Check that no big-end bearing binds.

10

Remove turning tool 9993590 from the flywheel housing and refit the covers.

Main bearings, changing all

This method describes changing main bearings with the crankshaft in situ.

Prior conditions:

Oil sump removed.

Special tool: 9993590

1



Fit turning tool 9993590.

2

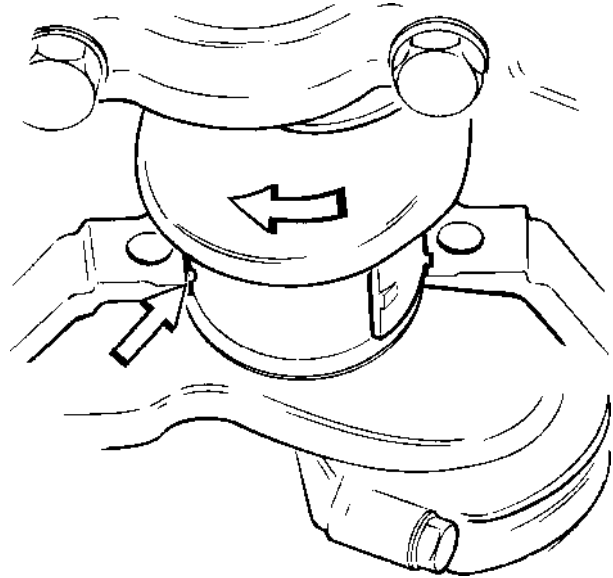
Remove the oil suction pipe and oil delivery pipe.

NOTE: The oil pump need not be removed.

3

Remove one main bearing cap at a time.

4



Remove the upper bearing shell. Insert a dowel in the crankshaft oil hole and roll out the bearing shell by rotating the crankshaft in the direction of rotation using turning tool 9993590.

5

Clean and inspect the bearing seat, cap, journal and shells.

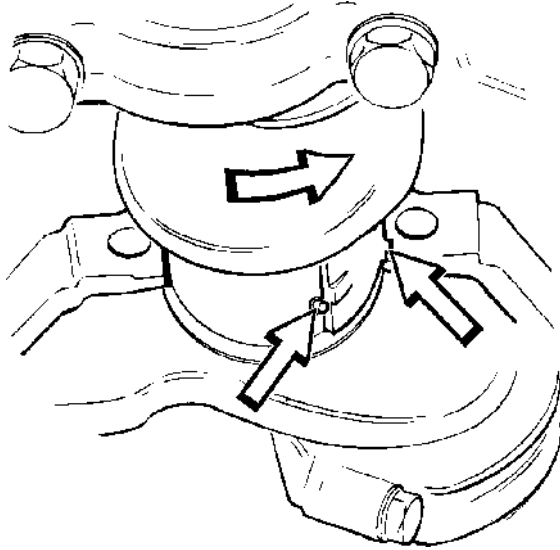
If the bearing has seized the cause must be determined before a new bearing is fitted.

6

Make sure that the right size is used when changing bearings.

NOTE: If uncertain, check the specifications to see which oversizes occur. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

7



Oil the journal and the new bearing shells.

8

Fit the upper bearing shell by using turning tool 9993590 to rotate the crankshaft against the direction rotation with the dowel in the oil hole.

NOTE: Check that the shoulder of the bearing shell fits correctly in the bearing seat.

Note that the upper bearing shells (those that are to be fitted in the cylinder block) incorporate oil holes.

9

Fit the main bearing cap together with the lower bearing shell. Tighten in two stages.

Stage 1 150±20 Nm.

Stage 2 angle tighten to 120°±5°

10

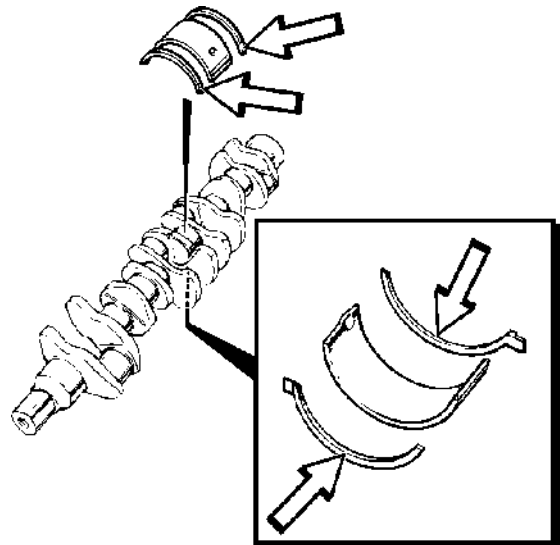
Change the other main bearings, one at a time, the same way as the first one. After changing each main bearing, check that the crankshaft does not bind. This is done by rotating it with turning tool 9993590.

11

Check the axial clearance of the crankshaft and change the axial bearing washers if the clearance is excessive or if the washers are damaged.

NOTE: Measure the axial clearance using a dial indicator. In regard to axial clearance, see "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

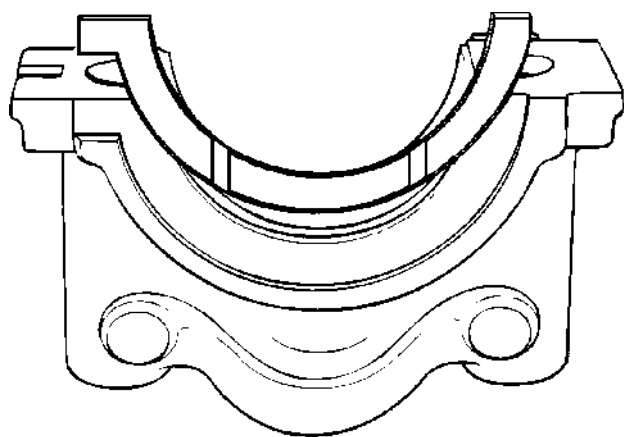
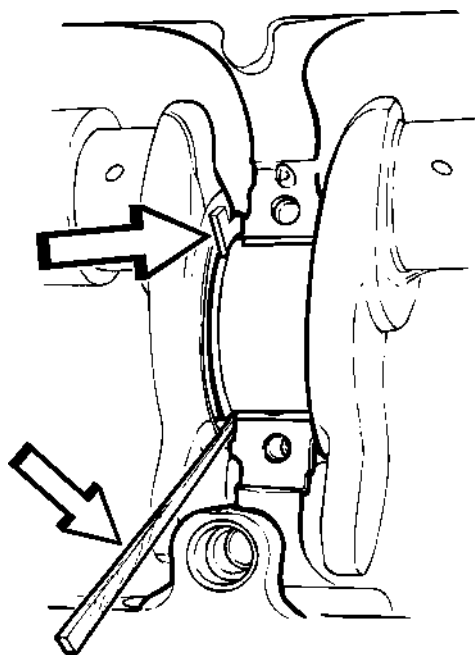
12



The crankshaft axial bearing is located in the center main bearing seat.

NOTE: The axial bearing washers are available in a number of oversizes, see "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

13



Use a thin plastic or wood stick to remove the axial bearing washers in the cylinder block bearing seats.

NOTE: The axial bearing washers are fitted in grooves in the main bearing cap.

14

Once all main bearing caps have been tightened to the specified torque, check the axial clearance of the crankshaft. See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE".

15

Fit the oil suction pipe and oil delivery pipe. See the instructions in the Service Manual.

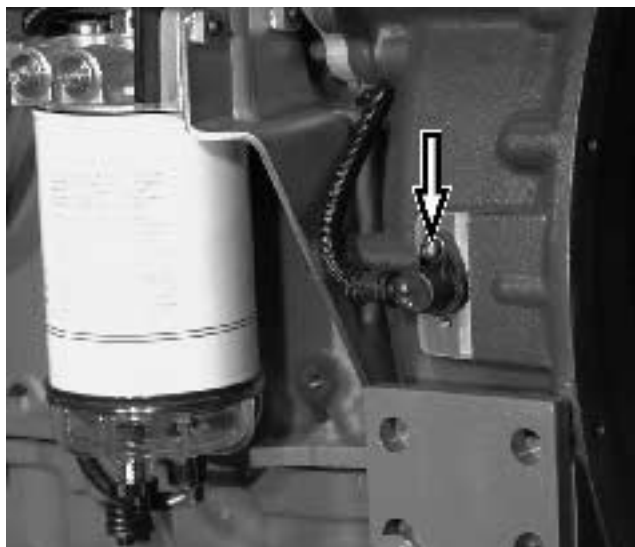
16

Remove turning tool 9993590 from the flywheel housing and refit the covers.

Flywheel, changing

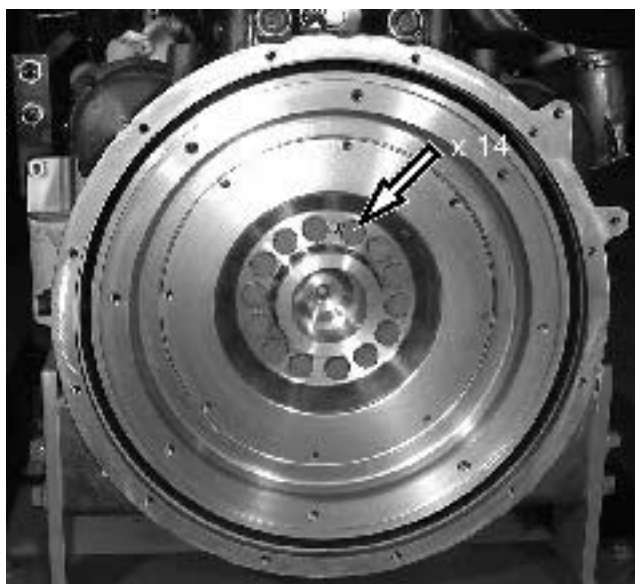
Special tool: 9998629

1



Remove the flywheel sensor.

2



Remove the flywheel.

3



Attach 2 lifting eyes 9998629 and lift away the flywheel (see illustration) with a lifting strap threaded through the lifting eyes.

NOTE: The flywheel weighs about 60 kg (132 lbs).

4

Thoroughly clean the crankshaft flange's contact surface against the flywheel.

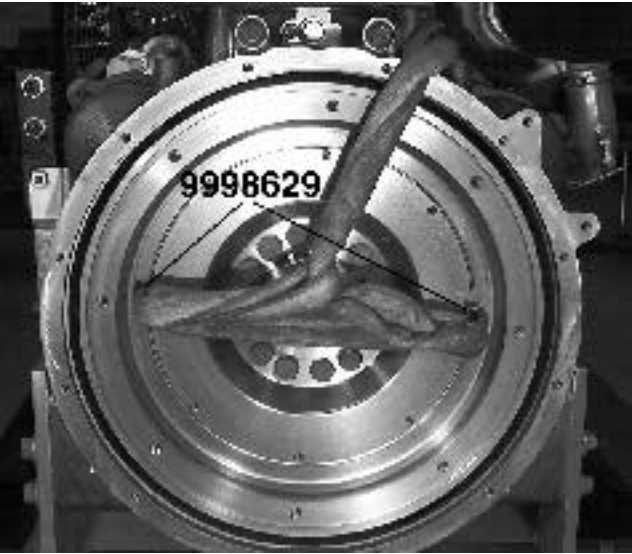
5

Thoroughly clean the flywheel's contact surface against the crankshaft flange and check that the surface at the location of the sensor grooves is completely free from impurities.

6

Check that the flywheel's guide pin in the crankshaft sits correctly in place and is free from damage.

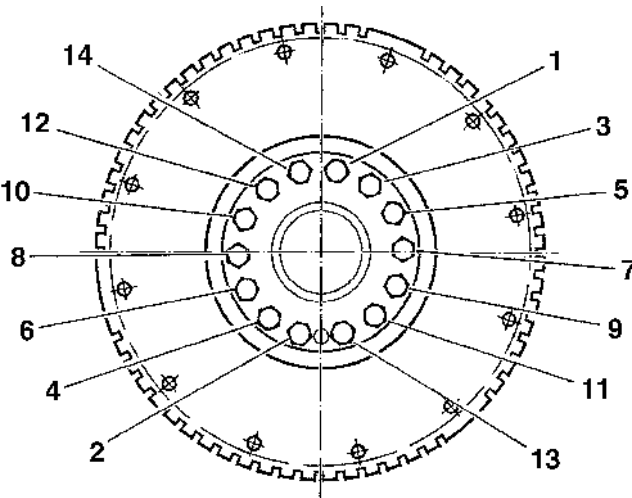
7



Attach 2 lifting eyes 9998629 and lift in the new fly-wheel (see illustration) with a lifting strap threaded through the lifting eyes.

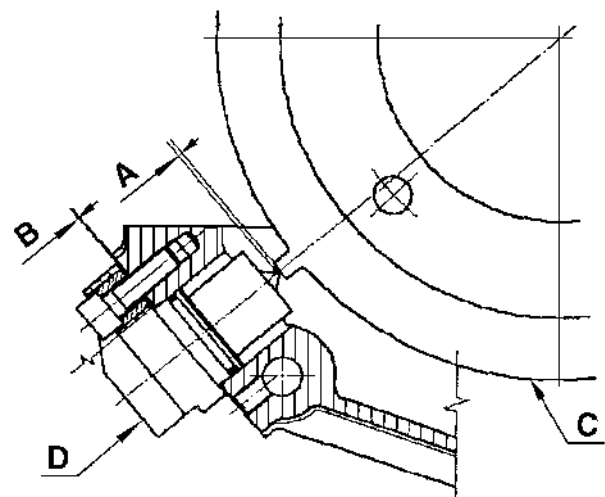
NOTE: The flywheel weighs about 60 kg (132 lbs).

8



Mount the flywheel and tighten the bolts to 245 ± 0.25 Nm in accordance with the tightening diagram.

9



A = clearance mm

B = shim

A	B	
Measured clearance	Shim	
	Quantity	Part no.
0.2–1.0 mm	–	–
–0.3 till 0.3 mm	1	1677894
–0.6 till –0.3 mm	2	1677894

Rotate the flywheel until a tooth on the camshaft's toothed wheel is opposite the sensor's hole in the fly-wheel housing.

Fit the flywheel sensor and measure the distance **A** between the sensor's tip and the flywheel.

Permissible clearance **A**: 0.6 ± 0.4 mm

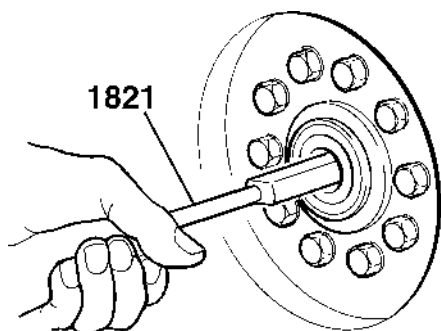
To obtain a correct signal from the flywheel sensor, the clearance between the sensor and the flywheel must lie within these limits. Adjust the sensor by means of shims in accordance with the above table.

Flywheel bearings, changing

Special tools, Mobile engines: 9991801, 9991821, 9992564 Stationary engines: 9992269

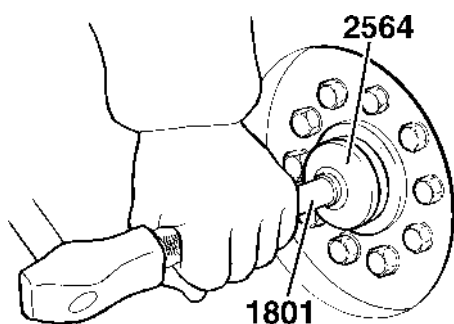
Mobile engines

1



Remove the flywheel bearing with tool 9991821.

2



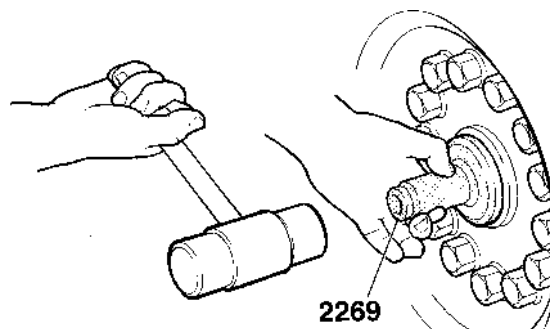
Fit the new flywheel bearing with drift 9992564 and handle 9991801.

Stationary engines

1

Due to the tight fit, the flywheel must be removed to be able to remove the flywheel bearing. Use a suitable drift to pry out the bearing.

2



Fit a new flywheel bearing using 9992269 and a plastic mallet.

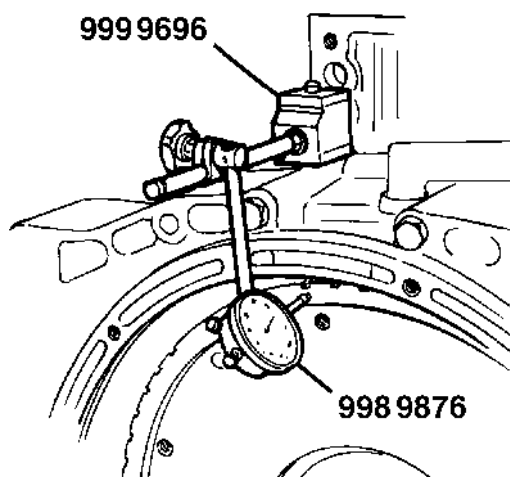
Flywheel, marking

Checking axial runout

Special tool: 9993590

Other special equipment: 9989876, 9999696

1



Mount a dial indicator 9989876 in magnetic stand 9999696 and reset the dial to zero with the tip against the flywheel.

2



Fit turning tool 9993590.

3

Rotate the flywheel with tool 9993590 and note the max. value on the dial indicator.

4

See "Technical data TAD1240GE, TAD1241GE/VE, TAD1242GE/VE and TWD1240VE" for measurement values.

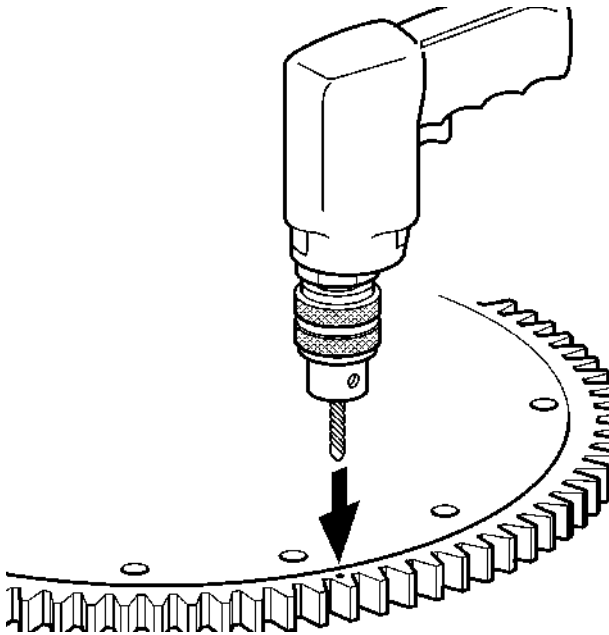
If the axial runout is excessive, remove the flywheel and check to see if there is any dirt or unevenness between the flywheel and the contact surface of the crankshaft.

5

NOTE: Do not forget to remove turning tool 9993590 from the flywheel housing and refit the covers.

Gear ring, changing

1

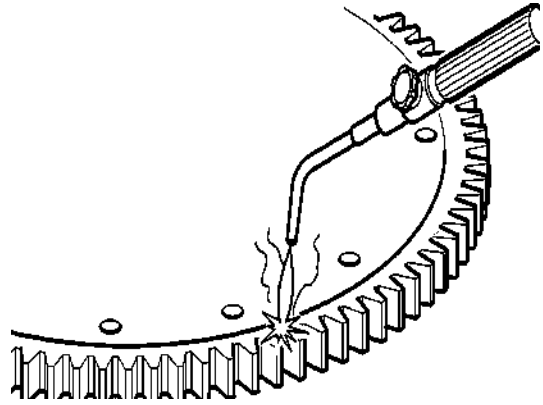


Drill 1-2 holes in a tooth gap on the gear ring. Use a chisel to split the gear ring at the drilled hole and lift the gear ring from the flywheel.

2

Clean the contact surface of the flywheel with a steel brush.

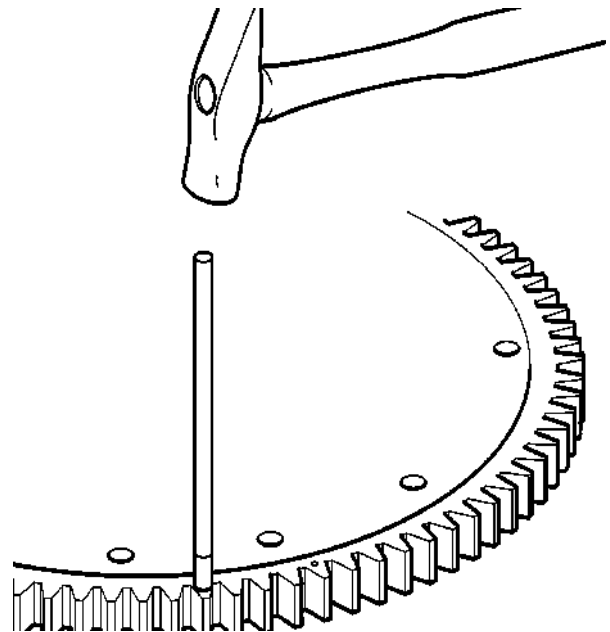
3



Heat the new gear ring with a welding torch or in an oven. The gear ring must be heated evenly. Heat the ring to 180-200° C (365-392° F), stopping when the polished surfaces become blue. Be careful not to heat the gear ring too much, as this will result in runout.

Check the heating by polishing the ring until glossy at some spots.

4



Place the warmed gear ring on the flywheel and tap it into position with a soft drift and hammer.

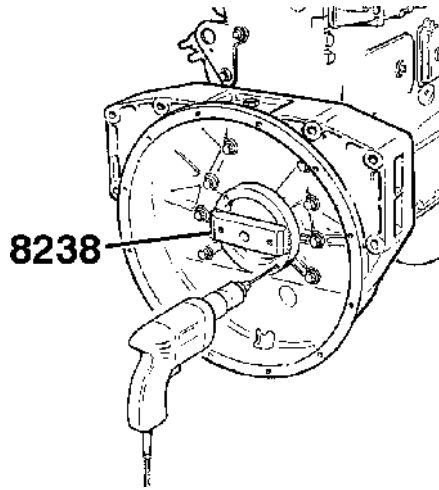
Allow the gear ring to cool.

Crankshaft seal, rear, changing

3

Special tools: 9992000, 9998238

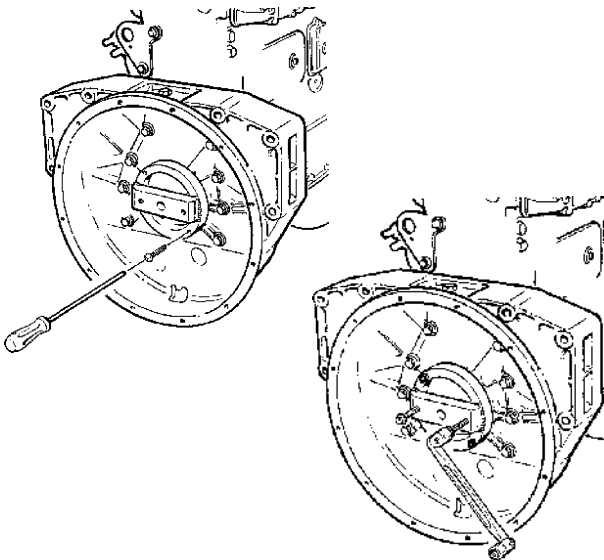
1



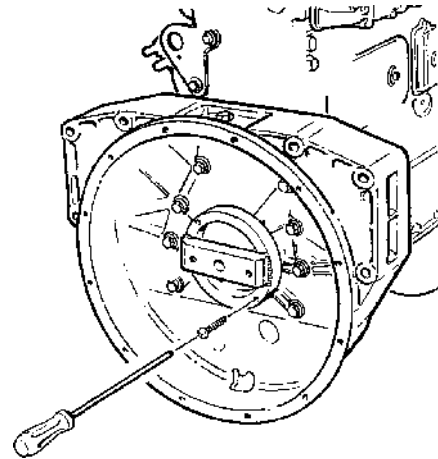
Fit tool 9998238 in the seal by turning the tool while pressing it inwards.

Drill two 4 mm holes in the metal edge of the seal by using the tool's locating holes as a template.

2



Screw two self-tapping screws (M5x35) in the seal through the tool's locating holes. Fit two screws (M10x60) with a long thread in the tool's threaded holes and withdraw the seal.

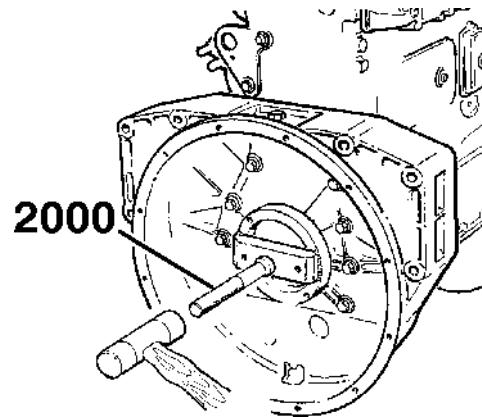


Remove the seal and the screws from the tool.

4

Clean the seal's place in the flywheel housing and the seal face against the crankshaft.

5



Spread sealant, part no. 11612314 on the outer surface of the new seal and oil the seal lip.

Carefully tap in the new seal with tool 9998238 and handle 9992000 until the tool bottoms against the flywheel housing.

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